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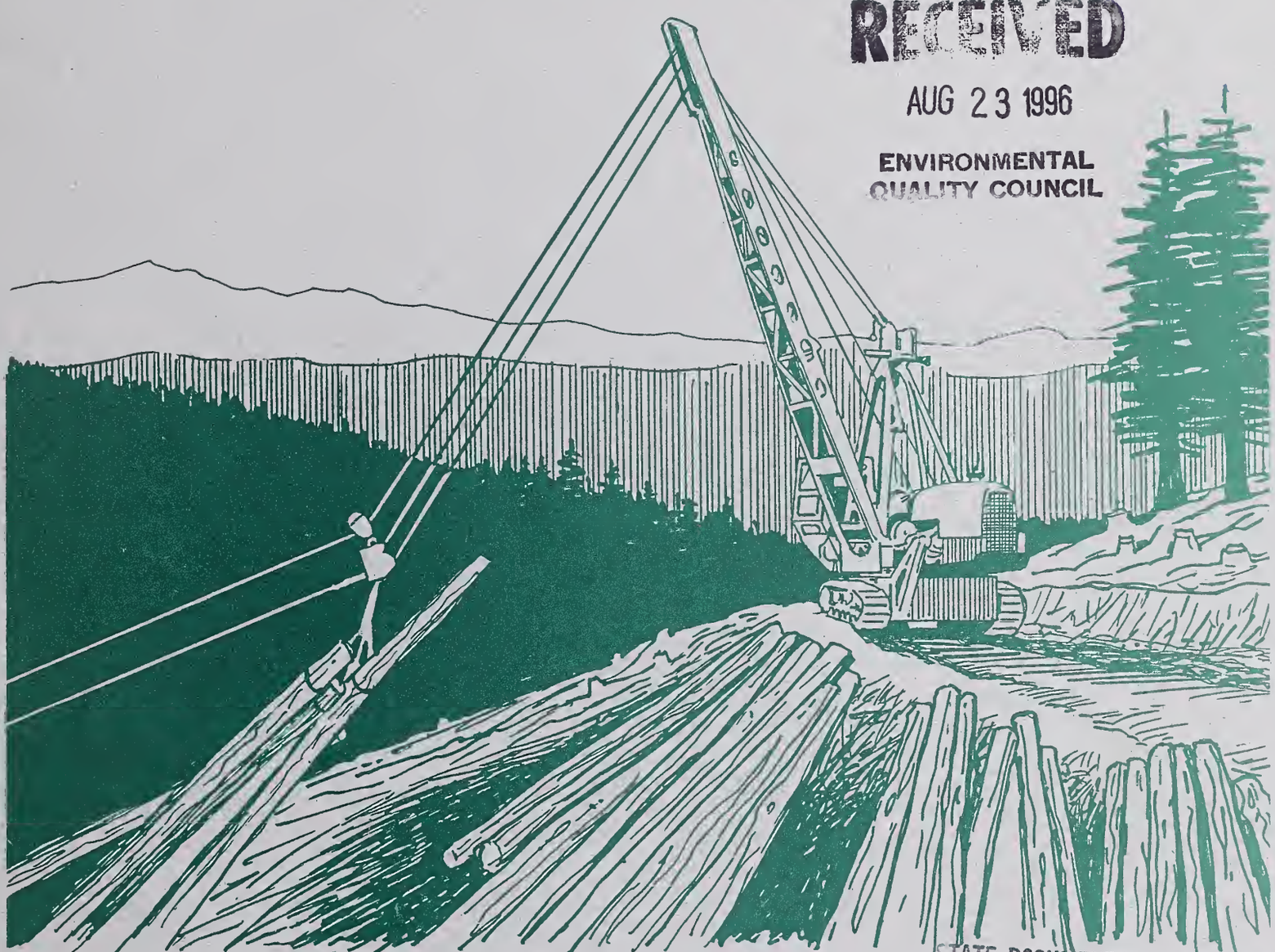

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FORESTRY BEST MANAGEMENT PRACTICES

IMPLEMENTATION MONITORING

THE 1994 FORESTRY BMP AUDITS
FINAL REPORT

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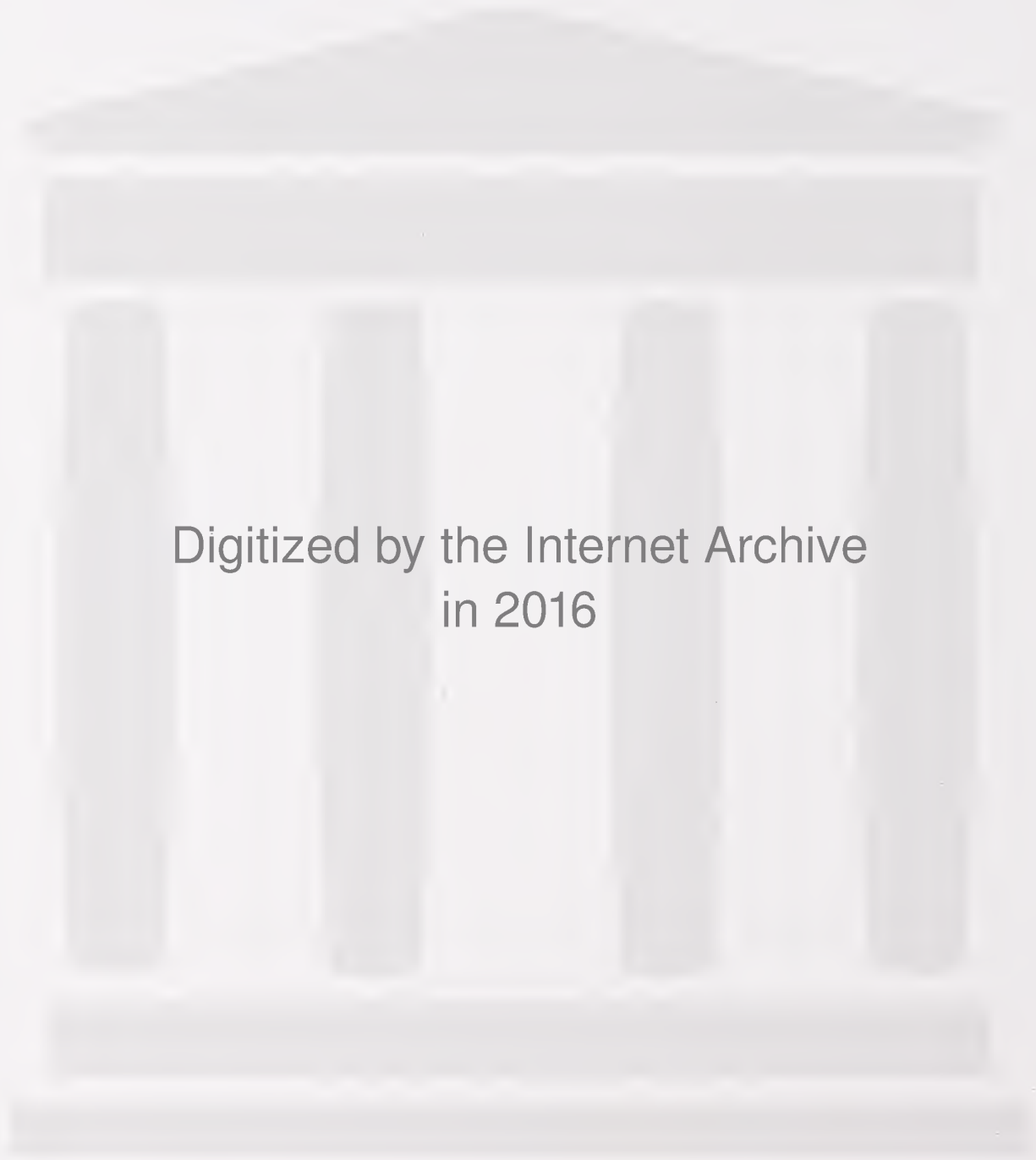
MONTANA DEPARTMENT OF STATE LANDS
FORESTRY DIVISION
MISSOULA, MONTANA 59801

Report Prepared by Gary Frank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EXECUTIVE SUMMARY

The Best Management Practice (BMP) audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution. In 1993 the Governor requested the Montana Department of State Lands (DSL), Forestry Division to evaluate forest practices for BMP implementation and report to the EQC before the 1995 legislative session. This report summarizes the findings of Montana's 1994 forestry BMP audits. A similar study and report was completed in 1990 and 1992.

Three interdisciplinary teams conducted the audits. Each audit team was composed of six members: a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. DSL used site selection criteria to choose 46 timber harvest sites harvested since 1992. The selection criteria limited the sample to those sites most sensitive to the practices that affect water quality. The audit teams evaluated a maximum of 55 practices at each site, rating application and effectiveness for each BMP on a 5-point scale.

The audit teams evaluated up to 55 practices on 46 sites, for a total of 1,917 practices rated for **BMP application**. Ninety-one percent of the practices rated on all sites met minimum BMP requirements. Most sites--39 of 46--had at least one minor departure from BMP application; 17 of 46 sites had at least one major departure. Both Federal and Non-Industrial Private sites averaged approximately 5 departures per site, which was higher than other ownership groups. The average for all ownership groups was 3.9 departures per site. Because practices vary greatly in their potential impact, the application of nine high risk BMPs was evaluated separately. Seventy-nine percent of the high risk BMPs met application requirements. High risk BMPs are among those most important for protecting watersheds.

The audit teams evaluated up to 55 practices on 46 sites for a total of 1,917 practices rated for **BMP effectiveness**. Ninety-three percent of the practices rated on all sites were judged to provide adequate protection. Thirty-one of the 46 sites audited were producing minor/temporary impacts to the soil and water resource; 13 of 46 sites had at least one major/temporary or minor/prolonged impacts; 1 site had major/prolonged impacts. The average number of minor/temporary impacts per site was 2.1; the average number of major/temporary or minor/prolonged impacts per site was .85; the average number of major/prolonged impacts per site was 0.09. Eighty-three percent of the nine high risk BMPs evaluated on each site were rated as providing adequate protection.

The greatest departure from BMPs, and the most impacts, were associated with road drainage. The text includes a list on pages 22-23 of problematic BMPs and BMPs that are usually applied properly.

The audit teams also evaluated application and implementation of the Montana Streamside Management Law and Rules during the 1994 audits. Either the law or both the law and the rules were applicable to 44 of the 46 audit sites. A total of 31 departures were noted on 23 of these 44 applicable sites. SMZ departures occurred on approximately 85% of the applicable Federal sites; 36% of the Industrial sites; 42% of the NIP sites; and 40% of the State sites. Equipment operation within the SMZ occurred on 12 of the sites and was the

most common departure. Most of the departures were minor in extent and produced no discernible impacts.

Ratings for application of BMPs were as follows: Industrial lands ranked highest among all ownership groups. State lands ranked second; results on Federal (USFS and BLM) and Non-Industrial Private (NIP) lands were similar, and both ranked third in BMP application.

In BMP effectiveness, the results for Industry (IND) and State lands were similar, and both ranked higher than the other ownership groups. NIP sites ranked third and Federal sites were ranked fourth in effectiveness.

Similar audits were conducted in 1990 and 1992 which can be compared to the 1994 results. The 1994 audits show improvement in the application and effectiveness of BMPs when compared with the 1990 and 1992 results.

Comparison of BMP Audit Results - 1994 vs. 1992 and 1990

	1994	1992	1990
Application of practices that meet or exceed BMP requirements.	91%	87%	78%
Application of high risk practices that meet or exceed BMP requirements.	79%	72%	80%
Number of sites with at least one major departure in BMP application.	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average number of departures in BMP application, per site.	3.9	5.6	9
Number of practices providing adequate protection.	93%	90%	80%
Number of high risk practices providing adequate protection.	83%	77%	58%
Number of sites having at least one major/temporary or minor/prolonged impact.	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average number of impacts per site.	3	4.6	8

Recommendations from 1994 Audit Team Members

- Continue the interdisciplinary forestry BMP audits. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Continue to evaluate implementation of the SMZ law and rules.

- Update the rating form. Adjust for the Streamside Management Act, and for recommended improvements to the rating guide and practices listed.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Lack of adequate drainage on new and existing roads continues to be the primary impact to water quality. BMP education should emphasize the need for meeting road drainage BMPs.

- Actively encourage the sites' owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DSL in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor and, if needed in the case of NIP lands, the DSL Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

INTRODUCTION

The forest lands of Montana form the headwaters of several of major river basins and produce large quantities of high quality water. This water nurtures some of the West's best fisheries, and is used for irrigation and livestock, as well as for domestic, recreational and industrial purposes. These same lands supply the logs that sustain the forest products industry, an important component of Montana's economy. All products from Montana's 22.5 million acres of forest land contribute in an essential manner to Montana's economy and way of life.

Montana's water quality protection program for forestry involves a combination of regulatory and non-regulatory approaches. Since the 1970's, voluntary Forestry Best Management Practices have provided guidance as minimum water quality protection standards for forestry operations.

The BMPs, if properly designed and effectively applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations often produce, such as sediment from a road or timber harvest. The BMP audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution.

Concern over the impacts of forest management on Montana's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "how current forest management practices are affecting watersheds in Montana." The EQC established a BMP technical committee that revised Montana's forestry BMPs in 1989.

Prior to 1990, forestry water quality was addressed through a voluntary approach. In 1990, the Legislature enacted the BMP Notification Law (76-13-101 MCA) which requires private landowners who plan to harvest timber to notify the state of their plans. Under this law, forestry BMP information is sent to landowners. Implementation of practices is voluntary. DSL Service Foresters review a limited number of high risk sites prior to timber harvest. Nearly all sites on private land reviewed during the 1994 audits were subject to the BMP Notification Law.

Since October 1991, the Streamside Management Zone (SMZ) Law (77-5-301 MCA) regulates forestry practices along streams. This law prohibits certain forest practices along stream channels. The 1992 BMP audits did not evaluate compliance with the SMZ law because most operations audited were completed prior to the effective date of the law. The 1994 audits, however, were designed to provide preliminary information on the application and implementation of the SMZ law and rules.

Forestry BMP audits have been conducted previously in Montana. As part of HJR-49, audit teams conducted the first State-wide assessment of forest practices for BMPs during the summer of 1988 (Zackheim, 1988). In 1989, the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, audited more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990). The Montana Legislature directed DSL to conduct further series of statewide BMP audits in 1990 and 1992 (Schultz, 1990 and 1992).

In 1993, the Governor requested the Montana Department of State Lands (DSL) Forestry Division to once again evaluate forest practices for BMP implementation and report to the EQC before the 1995 legislative session. This report summarizes the findings of Montana's 1994 forestry BMP audits.

The BMP audit process, which the EPA calls BMP implementation monitoring, is a widely-used means of evaluating forest practices. Implementation monitoring is a surrogate for water quality monitoring, a more quantitative approach. Water quality monitoring is a long-term and expensive endeavor. Water quality varies naturally due to variable geology, land forms, soils, and climatic events. Due to this variability, investigators have to collect large numbers of samples at the right time and over a long period of time to accurately characterize water quality.

Investigators use qualitative implementation audits to find out if BMPs are being applied and whether they are controlling erosion; they can use quantitative water quality monitoring to determine if BMPs are protecting beneficial water uses. Since BMPs are recognized by state and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of a such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site, to monitor their silvicultural non-point source control programs (NCASI, 1988). California, Idaho, Oregon, Utah, Minnesota, Washington, South Carolina, Texas and Florida all use a similar qualitative approach to assess the control of non-point source pollution from forest practices.

METHODS

The 1994 audits were conducted with similar objectives and criteria as the 1992 and 1990 audits in order to produce comparable results.

The objectives for the 1990 and 1992 BMP field audits were to:

1. Determine if BMPs are being applied on timber harvest operations.

2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.

3. Provide information on the need to revise, clarify, or strengthen BMPs.

4. Provide information to focus future study efforts by identifying subjects and geographic areas in need of further investigation.

In addition to those listed above, the 1994 field audits included one objective concerning the Montana Streamside Management Zone Law and rules:

5. Provide preliminary information on the implementation of the SMZ law and rules and evaluate general effectiveness of SMZs in protecting water quality.

DSL sought a broad range of participation in planning the 1994 audits, but since the audit was conducted with similar objectives and criteria, less planning was necessary than for previous audits.

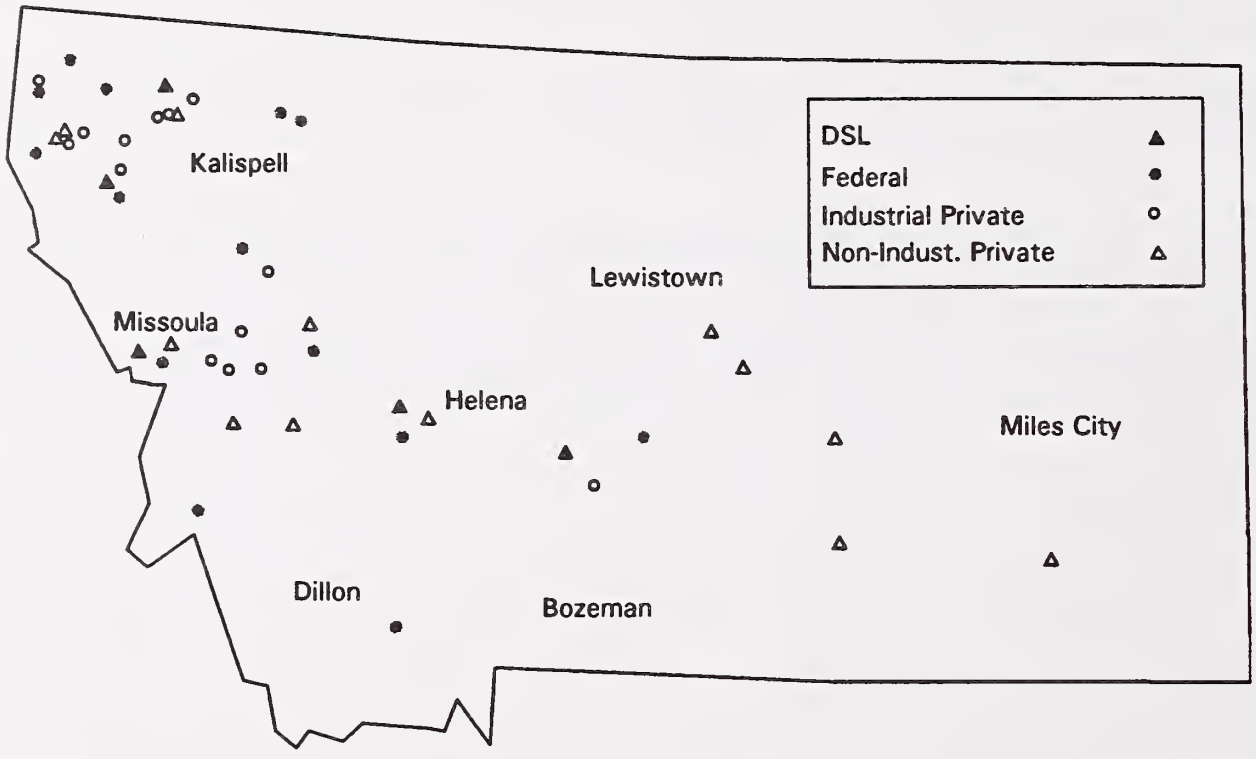
The Audit Teams

DSL designated three audit teams--one for the northwestern, one for the west central, and one for the southwestern and eastern parts of the State. Each team was composed of six members--a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. A member of each audit team was assigned to lead the team. The team leader was responsible for filling out the consensus rating form and for overseeing the logistics of the team. Team members were employees of federal and state agencies, private industry, independent consultants, and volunteers representing several conservation organizations. The Department of State Lands received a 319 grant from the EPA in part to pay volunteer members who could not participate as a part of their regular job. Continuity in team membership was excellent. Fourteen of the 18 team members from the 1992 audits participated in the 1994 audits. DSL named an alternate for each member in order to ensure a full range of interdisciplinary participation at each site. Most of the alternates had also participated in the 1992 audits. See Appendix A for a complete list of team members.

The Study Area

The Department expanded the study area to include the eastern half of the State in the 1994 audits. During the 1990 and 1992 audits the study area was limited to the western half of the state, where a majority of the timber harvest had occurred. Since that time, there has been a substantial increase in the volume of timber harvested in Eastern Montana. Approximately 48% of the statewide Non-Industrial Private harvest volume in 1992 came from east of the Continental Divide.

MAP # 1. GEOGRAPHIC DISTRIBUTION OF AUDIT SITES



Site Selection

The criteria for selecting sites was similar to the 1990 and 1992 audits, with an updated timeframe. The purpose in defining the criteria was to concentrate on sites that were more likely to have potential for water quality impacts. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. Selecting the sites was the responsibility of DSL.

The initial criteria for selection were:

- Sites were selected from areas with timber harvested in 1992, 1993, or 1994. Priority was given to most recently harvested sites.

- A portion of the sale needed to be located within 200 feet of a stream (see BMP definition).

- Minimum size for harvest units to be included in the audit process was five acres. Minimum timber removal was 5,000 board feet per acre. Some flexibility was allowed if smaller or low volume harvest met other criteria.

- The distribution of audit sites reflected the distribution of timber harvest in Montana, geographically, and by owner.

- Sites were classified into four land ownership classes--Nonindustrial Private, Industrial Private, Federal, and State. The number of sites per ownership group was to be proportional to the volume of timber each group harvested in 1992, the latest complete reporting period. A minimum of five sites per ownership class was audited.

For sites that met the initial criteria, DSL made further stratification:

- Sites with road construction or reconstruction and slash disposal completed were given first priority.

- Sites with road construction or reconstruction but slash disposal not completed were given second priority.

- Sites with slash disposal completed but no road construction were given third priority.

- Sites were further stratified by erosion hazard. Two-thirds of the audits were located on high erosion hazard sites. One-third were to be located on low to medium erosion hazard sites. This stratification was subject to availability of sites in the various hazard groups.

  Erosion hazard was determined as a function of slope steepness and erosivity based on geologic parent material and soil texture. Erosion hazard was stratified by ownership class so that a disproportionate number of high hazard sites did not fall in any one ownership class. Erosion hazard was determined using an erosion hazard matrix developed through the Montana Riparian Association. See Appendix B. Timber harvest in riparian zones was categorized as high hazard.

The number of days that team members would be able to conduct audits limited DSL to choosing 46 sites for the teams to visit. The maximum time commitment for audit team members was set at 10 days, since a longer commitment would likely jeopardize the ability of individuals to participate. On most days, teams could audit a maximum of two sites. See Appendix E for the list of the sites. The four ownership groups and number of sites audited were:

Ownership Group	Number of Sites Audited		
	1994	1992	1990
Federal (USFS and BLM)	14	16	16
Industrial Private	14	16	16
Non-Industrial Private	13	9	7
Dept. of State Lands	5	5	5
TOTAL	46	46	44

The goal for the audits was to have two-thirds of the sites in the "high hazard" category, as explained in the criteria for selecting sites. In order to meet the high hazard criteria, a site had either to rank high in a risk matrix that considers slope steepness, soil erodibility, and type of operation, or to be in a riparian zone. See Appendix B. Table 1 shows the percent of audited sites that, based on field evaluation, met the high hazard criteria, whether included by matrix, riparian, or both. Just under three-quarters of the total sites audited were high hazard. This is similar to the number of high hazard sites in 1990 and 1992.

Table 1

Percentage of Sites Meeting High Hazard Criteria

Ownership Group	Number of Sites	Matrix	Riparian	Matrix, Riparian or Both
Federal	14	64%	79%	86%
Industrial	14	36%	71%	79%
NIP	13	15%	46%	54%
State	5	60%	40%	60%
All Sites	46	41%	63%	72%

Members of all the ownership groups provided excellent cooperation as DSL selected sites. Industry and government supplied all information requested, and in most cases, in a very timely manner. DSL acquired the information about recent timber sales as follows: The affected National Forests and BLM searched their recent timber sales for sites that met some or all of the criteria. DSL finished refining the search where needed. For non-industrial and industrial private lands, DSL searched Hazard Reduction Agreements and Master Hazard Reduction Agreements for sites that met the criteria. DSL searched its own timber sale accounting program for sites that met the criteria.

DSL listed sites that met the criteria, by region within ownership groups. Sites to be audited were selected randomly from the pool of suitable sites within each ownership group. Only those sites with potential to impair water quality were judged to be suitable.

In the case of non-industrial private lands, DSL contacted landowners for permission to visit their lands. All of the landowners contacted granted audit teams access. Access to the other ownership groups was not an issue.

The size of audited sites varied greatly. See Table 2 for information on size of harvest units evaluated by ownership group. On very large sites, time did not allow the teams to review every acre of the site or every segment of new or existing roads. Teams concentrated on areas with the greatest potential for problems.

Table 2

Size of Harvest Units Evaluated By Ownership

Ownership Group	Number of Sites	Average Unit Size (Ac.)	Maximum Unit Size (Ac.)	Minimum Unit Size (Ac.)
Federal	14	26	40	5
Industrial	14	73	164	15
NIP	13	42	80	10
State	5	40	140	10
All Sites	46	47	164	5

Sample Size

Because the total number of cutting units in the State is not known, it is not possible to say what percentage of them the 46 sites represent. It is a representative sample of logging operations conducted in Montana since 1992 that meet the selection criteria. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality. The results are indicative of conditions for sites with potential to impair water quality. The results do not represent a sample of all timber harvest operations in Montana. The 46 sites represented approximately 1% of the total volume harvested in the state for the study period.

The Rating Form

The audit teams used a rating form similar to that of previous audits. See Appendix C for a copy of the form. The form was slightly revised for the 1994 BMP field audits to clarify unclear, incomplete or misleading statements. All of the revisions were made with the goal of keeping the format consistent with that used in past audits. The guide for rating

application and effectiveness was the same as used in the previous audits. The audit teams evaluated a maximum of 55 practices at each site, rating application and effectiveness for each on a 5-point scale.

The audit team rated the application of BMPs by first noting if the BMP was applicable to the site; then, if so, whether it was applied correctly and in the proper locations. Lack of adequate application or misapplication are departures from BMPs. The rating guide for application of BMPs was:

5 - Operation exceeds requirements of BMP.
4 - Operation meets requirements of BMP.
3 - Minor departure from intent of BMP.
2 - Major departure from intent of BMP.
1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. Ratings of 5 and 4 are self-explanatory. The 3 rating, minor departure, applies to departures of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The 2 rating, major departure, applies to departures of large magnitude or BMPs being repeatedly neglected. The 1 rating, gross neglect, applies where risks to soil and water resources were obvious and yet there was no evidence indicating that operators had applied BMPs to protect these resources.

The effectiveness rating answered questions concerning impacts. For example "has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, sediment delivery to streams?" Lack of effectiveness results in impacts. The rating guide for effectiveness was:

5 - Improved protection of soil and water resources over pre-project condition.
4 - Adequate protection of soil and water resources.
3 - Minor and temporary impacts on soil and water resources.
2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.
1 - Major and prolonged impacts on soil and water resources.

The work group defined these terms prior to the 1990 audits to help the audit teams use them consistently:

Adequate	-	Small amount of material eroded; material does not reach draws, channels, or floodplain.
Minor	-	Some material erodes and is delivered to draws but not to stream.
Major	-	Material erodes and is delivered to stream or annual floodplain.
Temporary	-	Impacts lasting one year or less; no more than one runoff season.
Prolonged	-	Impacts lasting more than one year.

The audit teams used a flow chart to help rate application and effectiveness, and, again, to keep the rating consistent. See Appendix D.

Audit Site Inspections

The first audit site inspection served as a calibration audit for the teams. Since most team members participated in previous audits, this session served as a refresher. The goal was to have the audit teams establish a consistent method of rating that could carry through the rest of the audits. Team members and alternates met for several hours of classroom instruction on the BMP audit process, and then evaluated the first audit site in the field. The team members shared their results with the other members, and identified and discussed their differences and ways to be consistent.

The teams conducted the audits July through September of 1994. The field routine consisted of meeting at a central location in the morning of each audit day. Teams traveled to the audit site. On site, the team leader provided maps and audit forms. Usually a representative of the landowner briefed the team by giving background information on the silvicultural prescription, time of operation, and associated practices. Team members walked the site, reviewing potential impact areas such as roads, streams, streamside management zones (SMZs), skid trails and firelines. Teams typically spent about two hours inspecting each site. After finishing the inspection, the team gathered to discuss the rating while still on site. The team leader was charged with leading the discussion and recording the consensus rating for each item on the rating form. The team also completed a supplemental questionnaire which evaluated the implementation of the SMZ law and rules (all applicable sites). Each team completed a single rating form and supplemental SMZ questionnaire for each site. For ratings where the team could not reach consensus, the team took a vote and recorded the rating with the most votes. The team leader noted dissenting values in the Comments section. Teams almost always reached consensus. Thirty-two individual ratings came to a vote. Most of these were on sites reviewed by the Northwest Team.

Limitations of the Audit Methods (in part, adapted from Idaho DHW, 1989.)

In analyzing the audit results, readers need to consider the limitations of the techniques used in the audit. The audit technique consisted of a one-time field inspection and assessment. This approach documents erosion and sedimentation problems which occur in the first or second year after harvest. This is generally the critical period for erosion associated with timber harvests. Some practices conducted during harvest cannot easily be evaluated in post-harvest audits. The assessment was based on visual appraisal of practices and impacts to surface soils and streams. The results are a snapshot-in-time of the practices and subsequent impacts. They do not necessarily reflect future impacts.

Sites were split among three teams. There are likely some differences in how the teams may have rated individual items. Lack of consistency is probably not a big problem, based on discussion with other teams and through overlap of team members on some audits, but it should not be overlooked.

Also, auditors may rate several practices connected with one action. In some cases, one action may result in more than one rating. For example, if a skidder operates extensively in the Streamside Management Zone, the practice may rate poorly under both "Adequate SMZ Maintained" and "Equipment Operation Minimized in SMZ." Even given these limitations, the BMP audit process is an effective way to evaluate the implementation of BMPs. In addition, the audit process has helped promote BMPs and encouraged landowners and operators to protect water quality on managed forests.

RESULTS

The results of the 1994 BMP field audits are presented in several categories, including application of BMPs, effectiveness of BMPs, a supplemental question on cumulative watershed effects, the SMZ law and rules evaluation, and the comparison of the 1994 results with previous audit results.

There are several ways to analyze and summarize the qualitative data generated by this study. One method is simply to look at what percent of the practices audited for BMPs fell into each rating category, by ownership group. This information is presented, for application and effectiveness of BMPs respectively, in Tables 3 and 6. While this is useful information for some purposes--including documenting problem BMP areas and comparing these results with other audits--readers should not base their conclusions on these simple percentage ratings. Appendix F tabulates how the ownership groups complied with each BMP.

All the practices evaluated in the audits can have an effect on water quality, but vary greatly in their potential impact. For example, BMPs in the "Road Planning and Location" section do not have as direct a potential impact on water quality as the practices in "Providing Adequate Road Surface Drainage" or "Adequate SMZ Maintained."

High Risk BMPs

Focusing on the simple percentages will not give a clear picture of how well or poorly Montana's watersheds are being protected. Even a low percentage of misapplied BMPs can still result in serious impacts. To provide several perspectives, the data has been analyzed in different ways. In particular, a subset of nine high risk BMPs has been analyzed separately. These nine high risk BMPs are among the most important for protecting Montana's watersheds. The nine high risk BMPs are:

BMP Number	Practice Description
I.C.1	Provide adequate road surface drainage for all roads.
I.C.6	Route road drainage through adequate filtration zones before entering a stream.
I.D.2	Stabilize erodible soils (i.e., seeding, benching, mulching).
I.E.2	Maintain erosion control features (dips, ditches and culverts functional).
II.A.5	Design and locate skid trails to avoid concentrating runoff.
II.B.1	Adequate SMZ maintained.
II.C.2a	Adequate drainage for temporary roads, skid trails, fire lines.
II.D.9	Limit water quality impacts of prescribed fire.
III.C.3	Prevent erosion of culvert and bridge fills (i.e., armor inlet and outlet).

The results for application and effectiveness of the nine high risk BMPs is presented in Tables 4 and 7, and Figure 1. Tables 5 and 8 summarize the data on a site basis, displaying the

percent of sites with departures or impacts and the average number of departures or impacts per site.

Some Practices Not Rated

The number of practices rated represents 76% of the total possible number of practices. Some BMPs did not apply to a site: some sites did not have stream crossings or new road construction; most sites did not have borrow pits; in several instances, slash disposal and site preparation had not been completed. In other cases, the audit team could not rate the BMP at the time of the audit--BMPs having to do with timing of operations during the harvest cannot be judged post-harvest.

Application of BMPs

The application rating measures whether the BMP was applied, whether it was applied correctly, and whether it was applied in the proper locations. See "The Rating Form" section on pages 10-12 for further explanation of the application rating. The audit teams evaluated a total of 1,917 practices to assess how landowners and operators applied BMPs. Table 3 lists the percent of practices that fell in each application rating category, by ownership group. Rather than focusing on simple analysis, the reader should refer to other tables (Tables 4, 5, 7 and 8) that better indicate how well Montana's watersheds are being protected.

Table 3

Application of BMPs to All Rated Practices by Ownership Group and Rating Category

Ownership Group	# Practices Rated	Percent (%) Practices Rated As			
		Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
Federal	588	88%	8%	4%	0.3%
Industrial	586	95%	4%	1%	0%
NIP	518	88%	8%	4%	0.2%
State	225	92%	8%	0%	0%
All Sites	1,917	91%	7%	3%	0.2%

Table 4 shows the BMP application for the nine high risk BMPs that were evaluated separately (see page 14). The percent of practices with departures is higher for the high risk group (Table 4) than for all audited practices (Table 3), as shown in Figure 1.

Table 4

Application of High Risk BMPs by Ownership Group and Rating Category

Ownership Group	# Practices Audited	Percent (%) Practices Rated As			
		Meet or Exceed	Minor Departures	Major Departures	Gross Neglect
Federal	126	73%	16%	10%	1%
Industrial	126	88%	11%	1%	1%
NIP	117	75%	13%	11%	1%
State	45	85%	15%	0%	0%
All Sites	414	79%	13%	7%	1%

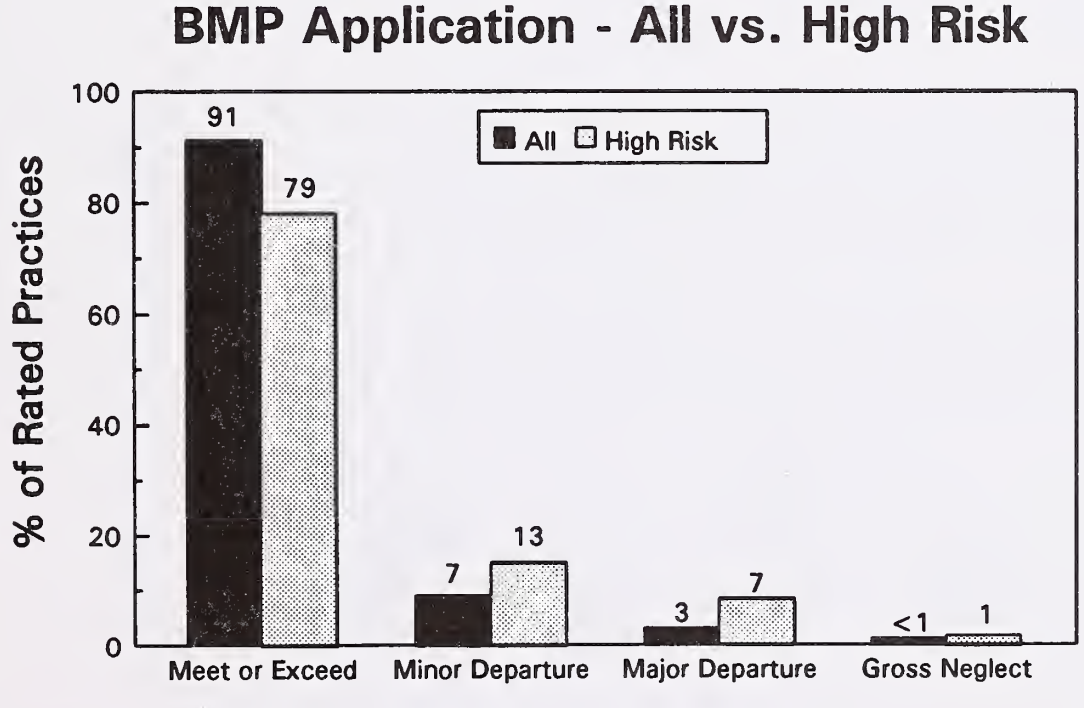


Figure 1.

Table 5 shows what percentage of sites departed from BMPs, and the average number of departures per site. The average number of departures per site includes all the sites, not just the sites with departures. Table 5 shows that most sites 85%--39 of 46--had at least one minor departure. It also shows that 37%--17 of 46--sites have at least one major departure in BMP application.

Table 5

Audit Sites with Departures from BMP Application and Average Number of Departures per Site

		Percentage (%) of Sites with Departures			# of Departures/Total # of Sites = Ave. #/Site		
Ownership Group	Total # of Sites	Minor	Major	Gross	Minor	Major	Gross
Federal	14	86%	43%	7%	3.1	1.8	0.14
Industrial	14	79%	27%	0%	1.7	0.21	0
NIP	13	85%	62%	8%	3.0	1.8	0.08
State	5	100%	0%	0%	3.4	0	0
All Sites	46	85%	37%	4%	2.7	1.1	0.07

Effectiveness of BMPs

The effectiveness rating evaluates how well BMPs protected soil and water resources. See page 11 for further explanation of the effectiveness rating. The audit teams evaluated a total of 1,917 practices to see how effective the BMPs were. Table 6 provides a summary of the effectiveness of all practices audited, by ownership group.

As with the corresponding table for BMP application (Table 3), this information should be used with discretion. While simple percentage ratings may be relatively high for the category Adequate Protection, poor effectiveness of a single BMP may still result in impacts.

Table 6

Effectiveness of BMPs for All Rated Practices by Ownership Group and Rating Category

Ownership Group	Number of Practices Rated	Percentage (%) Practices Rated As			
		Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	588	89%	7%	4%	1%
Industrial	586	97%	2%	1%	0%
NIP	518	90%	8%	2%	0%
State	225	97%	3%	0%	0%
All Sites	1,917	93%	5%	2%	0.2%

Figure 2 presents the percent of practices audited that are contributing to impacts by ownership group. This figure shows differences among ownership groups in effectiveness of their BMP implementation.

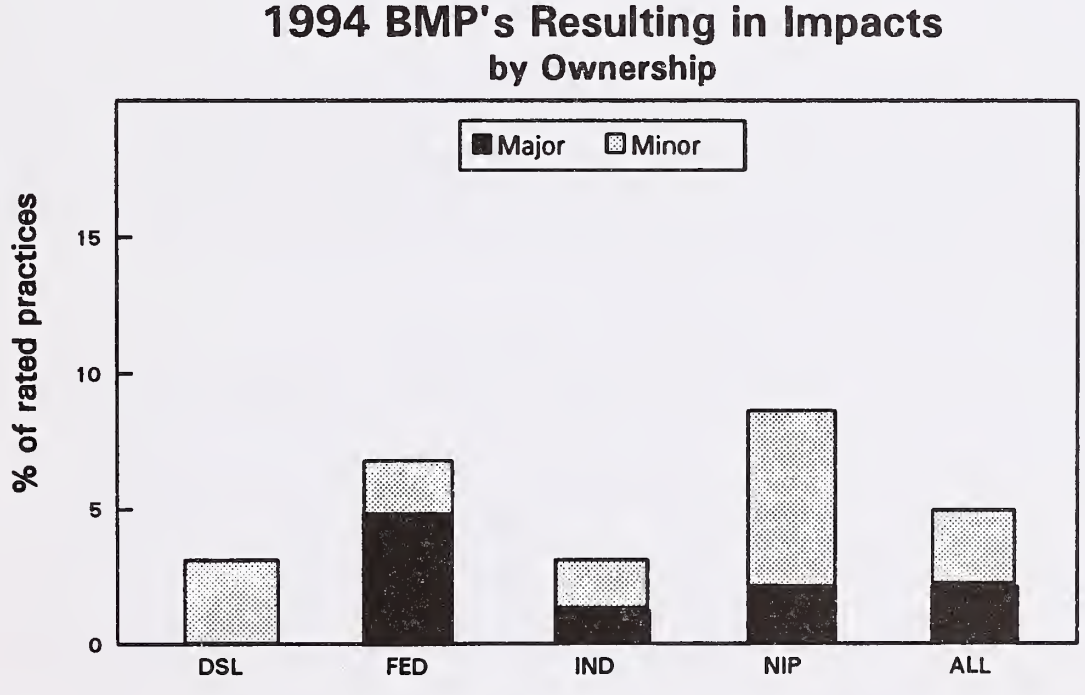


Figure 2. Major impacts are practices with an effectiveness rating < 3. Minor impacts are practices with effectivness rating of 3.

Table 7 shows the effectiveness of the nine high risk BMPs listed on page 14. The percent of practices providing adequate protection is lower for the high risk BMPs than for the total BMP results presented in Table 6. The percent of practices resulting in impacts is higher for the high risk BMPs than for practices in general.

Table 7

Effectiveness of High Risk BMPs
by Ownership Group and Rating Category

		Percentage (%) Practices Rated As			
Ownership Group	Number of Practices Audited	Adequate Protection	Minor/Temp. Impacts	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	126	76%	13%	10%	1%
Industrial	126	93%	6%	2%	0%
NIP	117	75%	18%	7%	0%
State	45	93%	7%	0%	0%
All Sites	414	83%	12%	6%	0.3%

Table 8 lists the percentage of sites with impacts and average number of impacts per site. This table shows that 67% of the sites audited were producing at least minor/temporary impacts--at an average of 2.1 per site. 28% of all sites were producing major/temporary impacts--an average of 0.8 per site. This analysis illustrates that, while the percentage of practices rated as providing adequate protection may be quite high (93%), impacts were still occurring on a majority of the sites audited.

Table 8

Audit Sites with Impacts and Average Number of Impacts per Site

Ownership Group	Total # of Sites	Percentage (%) of Sites with Impacts			# of Impacts/Total # of Sites = Ave. #/Site		
		Minor/ Temp.	Major/Temp., Minor/ Prolonged	Major/ Prolonged	Minor/ Temp.	Major/Temp., Minor/ Prolonged	Major/ Prolonged
Federal	14	93%	43%	7%	2.7	1.6	0.29
Industrial	14	36%	21%	0%	0.86	0.14	0
NIP	13	77%	31%	0%	3.0	0.92	0
State	5	60%	0%	0%	1.2	0	0
All Sites	46	67%	28%	2%	2.1	0.80	0.09

Cumulative Watershed Effects

The audit teams answered a supplemental question addressing cumulative watershed effects:

> Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production?

The audit teams judged landowners to have considered cumulative effects if they had assessed at least one of the following: water yield, sediment yield, or the total amount of timber harvest that had occurred in the basin, compared to the size of the basin.

Ownership Group	Sites Where Landowners Assessed Cumulative Effects
Federal	14 of 14 = 100
Industrial	7 of 14 = 50%
NIP	6 of 13 = 46%
State	5 of 5 = 100%
All Sites	32 of 46 = 70%

DISCUSSION

Table 3 indicates that 91% of the practices applied on all sites met or exceeded BMP standards. This type of analysis does not accurately represent the impact that practices have had on the audited sites. Not all practices are equally important for protecting water quality. 79% of high risk BMPs, as listed in Table 4, met BMP requirements.

18% of the high risk BMPs resulted in impacts, as shown in Table 7. Table 8 indicates that 67% of the audited sites (31 out of 46) produced minor/temporary impacts and 28% (13 out of 46) produced either major/temporary or minor/prolonged impacts. One of the sites produced major/prolonged impacts. Most of these impacts could have been prevented if landowners and operators had properly applied BMPs.

As was true for the 1990 and 1992 audits, the results of the 1994 audits show that the greatest departure from BMPs, and the most impacts, were associated with road drainage. Improper installation of or lack of slash filter windrows, insufficient maintenance of erosion control features and drainage and poor skid trail design, location, and drainage also resulted in a large number of deficiencies in application and impacts.

The list that follows is of individual BMPs that most often are not properly applied or result in impacts, ranked in order, by the sum of departures and impacts. Rankings from the 1990 and 1992 audits are listed in parenthesis. (-) indicates not frequent enough to be in the top 18 in that year.

1994	1992	1990	Practice Description	Practice #
1.	(3.)	(1.)	Provide adequate road surface drainage for all roads.	I.C.1
2.	(2.)	(3.)	Route road surface drainage through adequate filtration zones before entering a stream.	I.C.6
3.	(13.)	(19.)	Direct road drainage away from stream crossing site.	III.B.1b
4.	(-)	(-)	Slash filter windrows installed.	I.D.3
5.	(-)	(-)	Maintain erosion control features (dips, ditches and culverts functional).	I.E.2
6.	(1.)	(6.)	Adequate drainage for temporary roads, skid trails, and fire lines.	II.C.2a
7.	(5.)	(9.)	Design and locate skid trails to avoid concentrating runoff.	II.A.5
8.	(15.)	(4.)	Stabilize erodible soils (i.e., seeding, benching, mulching).	I.D.2
9.	(10.)	(2.)	Prevent erosion of culvert and bridge fills (i.e., armor inlet and outlet).	III.C.3
10.	(-)	(-)	Culverts conform to natural streambed and slope.	III.C.2
11.	(-)	(-)	Provide energy dissipators at drainage structure outlets where needed.	I.C.4
12.	(-)	(-)	Reconstruct only to the extent necessary to provide adequate drainage and safety.	I.D.10
13.	(8.)	(18.)	Skidding operation minimizes soil compaction and displacement.	II.C.1a
14.	(-)	(-)	Avoid incorporating woody debris in road fill.	I.D.6
15.	(-)	(-)	Locations avoid high hazard sites (i.e., wet areas and unstable slopes).	I.A.4
16.	(-)	(-)	Streams free of logging debris.	II.B.4
17.	(-)	(-)	Vary road grade to reduce concentrated drainage.	I.B.4

These 17 practices accounted for 72% of all departures and 73% of all impacts. The remaining BMPs had a lower frequency of departures in application or resultant impacts.

The following practices were on the 1992 list of BMPs most often not applied or resulting in impacts but did not make the list in 1994. The number in parenthesis on the left is the ranking from the 1992 report.

(4.)	Adequate SMZ maintained	(IIB1)
(6.)	Limit water quality impacts of prescribed fire	(IID9)
(7.)	Grade roads to maintain drainage	(IE1)
(9.)	Avoid equipment operations in wetlands	(IIB3b)
(11.)	Minimize equipment operation in SMZ	(IIB3a)
(12.)	Cut and fill slopes at stable angles	(ID5)
(14.)	Minimize compaction and displacement of soil	(IID5)
(16.)	Adequate roadside SMZ	(IA5)
(17.)	Restrict road use when wet	(IE6)
(18.)	Dozer operations on suitable slopes	(IID6)

On the positive side, the 1994 audits showed that the following BMPs were nearly always properly applied, resulting in few impacts (three or fewer minor/temporary impacts).

- Most BMPs related to road planning and location (I.A).
- Designing roads to minimum standard necessary to accommodate uses (I.B.2).
- Proper sizing for crossing structures (I.B.5).
- Suitable logging system for topography, soil types and season of operation (II.A.2).
- Suitable location, size, and number of landings (II.A.6).
- Most BMPs related to streamside management (II.B).
- Skidding operation minimizes compaction (II.C.1.b).
- Adequate drainage for landings (II.C.2.b).
- Scarify only to the extent necessary (II.D.4).
- Equipment operation on suitable slopes only (II.D.6).
- Cross streams at right angles if practical (III.B.1.a).
- Avoid unimproved stream crossings (III.B.2).
- Minimize stream channel disturbance (III.C.1).
- Minimum cover for culverts provided (III.C.5)
- Adequate storage and disposal for fuel, waste oil (V.A).

Logging contractors attended 10 out of the 46 audits. Team members felt it was beneficial for all if contractors attended.

Audit team members noticed a range of potential or actual water quality impacts that are not reflected in the results. Both grazing and mining impacts were observed at several audit sites. In some cases, road erosion problems were the result of other land uses.

Streamside Management Zones

A supplemental questionnaire was added to the 1994 BMP audits to evaluate the application and implementation of requirements of the SMZ law and rules. This survey did not constitute a DSL enforcement action. Audit team members evaluated departures based on their best professional judgment, despite limited experience with the SMZ law and rules. Practices conducted in the SMZ were also evaluated under the BMP rating form, using the BMPs as the standard. This was done to provide a means of direct comparison with the results of the previous audit efforts.

Either the law or both the law and the rules were applicable to 44 of the 46 sites. The remaining two sites did not have stream channels that meet the definition of a stream contained in the law. The law alone was applicable on 11 of the 44 sites, and both the law and the rules were applicable to some phase of the harvest operation (road construction, harvest or slash disposal) on 33 of the 44 sites.

Harvest of trees within the SMZ occurred on 40 of the 44 sites. No pre-approved alternative practices, as allowed under the rules, were utilized on any of the sites evaluated. However, one site-specific, DSL-approved (not pre-approved under the rules) alternative practice, which allowed equipment operation within the SMZ under frozen or snow-covered conditions, was evaluated.

A total of 31 departures from either the law or rules were noted on 23 of the 44 applicable sites. SMZ departures occurred on 85% of the applicable Federal sites and approximately 40% of the applicable sites for all other ownership groups (see Table 9).

Table 9

SMZ Departures by Ownership Group

Ownership Group	Number of Sites Evaluated	Number of Sites With Departures	Total Number of Departures
Federal	13	11	18
Industrial	14	5	5
NIP	12	5	6
State	5	2	2
All Sites	44	23	31

Equipment operation within the SMZ was the most common departure and occurred on 12 of the sites. Other practices with the most departures included clearcutting within the SMZ or failure to meet the retention tree requirements, and logging slash deposited in streams (see Table 10). There were six instances of the clearcutting within the SMZ.

Table 10

SMZ Departures by Practice

Practice	# Departures
Broadcast Burning In SMZ	1
Equipment Operation in SMZ	12
Clearcutting/Retention Tree Requirements	9
Road Construction in SMZ	2
Sidecasting into Stream	2
Slash Deposited into Stream	5

Failure to mark or properly locate SMZ boundaries was observed on 17 sites. Improper SMZ delineations alone cannot be considered to be the sole cause of other departures at these sites. SMZ departures were noted on seven sites with properly located and marked SMZ boundaries. One site had no departures despite incorrect SMZ delineation. However, incorrect SMZ boundary delineation was judged to be a factor in contributing to 20 other departures at 14 sites.

Although 31 departures were noted on 23 of the sites, most of the departures were minor in extent and produced no discernible impacts. For example, 9 of the 12 departures due to equipment operation in the SMZ consisted of one or two skid trails that were not located in immediate proximity to the stream. Audit teams determined that all but 3 of the SMZs were still effective in protecting water quality.

Results by Ownership Group

There are notable differences among the ownership groups in their application and effectiveness of all BMPs. Ratings for application of BMPs were as follows: Industrial lands ranked highest among all ownership groups. State lands ranked second; results on Federal (USFS and BLM) and Non-Industrial Private (NIP) lands were similar, and both ranked third in BMP application. In BMP effectiveness, the results for Industry (IND) and State lands were similar, and both ranked higher than the other ownership groups. NIP sites ranked third and Federal sites were ranked fourth in effectiveness. See Figure 2. Non-Federal lands exhibited the highest average number of departures per site. Six of fourteen sites on Federal lands had major or prolonged impacts (an effectiveness rating less than 3).

Comparison with Previous Audits

The 1994 audits were conducted in a manner directly comparable to the 1990 and 1992 audits. The same selection criteria and rating format were used. Most audit team members had participated in the 1990 and 1992 audits. Earlier audits, conducted in 1988 and 1989, were similar, but had differences in design and format. The most accurate comparison is between the 1990, 1992 and 1994 audits.

The 1994 audits show overall improvement in the application and effectiveness of BMPs when compared with the 1990 and 1992 results. See Table 11 for a comparison of the 1990, 1992 and 1994 results.

Table 11

Comparison of BMP Audit Results: 1994 vs. 1992 and 1990

	1994	1992	1990
Application of Practices that Meet or Exceed BMP Requirements	91%	87%	78%
Application of High Risk Practices that Meet or Exceed BMP Requirements	79%	72%	53%
Number of Sites with At Least One Major Departure in BMP Application.	17 of 46 (37%)	20 of 46 (43%)	27 of 44 (61%)
Average Number of Departures in BMP Application, Per Site.	3.9	5.6	9
Number of Practices Providing Adequate Protection	93%	90%	80%
Number of High Risk Practices Providing Adequate Protection.	83%	77%	58%
Number of Sites Having At Least One Major Temporary or Minor Prolonged Impact	13 of 46 (28%)	17 of 46 (37%)	28 of 44 (64%)
Average Number of Impacts Per Site	3	4.6	8

Non-industrial private sites showed the most improvement over 1990 and 1992 results. In 1990, NIP sites averaged 15 impacts per site. In 1992, NIP sites averaged 10 impacts per site. In 1994, NIP sites averaged 4 impacts per site. Minor/temporary impacts and major/temporary impacts were both reduced, and there were no major/prolonged impacts on NIP sites.

State lands showed increases in the percentage of practices rated with minor departures and minor/temporary impacts in 1994. Minor departures in application increased from 3% in 1990 to 8% in 1994. Minor/temporary impacts increased from 1% in 1990 to 3% in 1994. State lands was the only ownership group that had no major departures or major/temporary, or prolonged impacts.

Industrial lands continued to show improvement. 21% of the Industrial sites had major/ temporary or minor/prolonged impacts in 1994. In 1992, 31% of the sites had such impacts, while in 1990 the percentage was 69%. There were no major/prolonged impacts on Industrial lands in the 1994 audit.

For application, Federal lands showed small increases in the percentage of sites with minor and major/temporary impacts in 1994. Federal sites showed a small decrease in the

percentage of practices rated as minor departures, but also showed a small increase in the percentage of practices rated as major departures.

Figure 3 displays BMP application results for the four forestry BMP audits conducted in Montana.

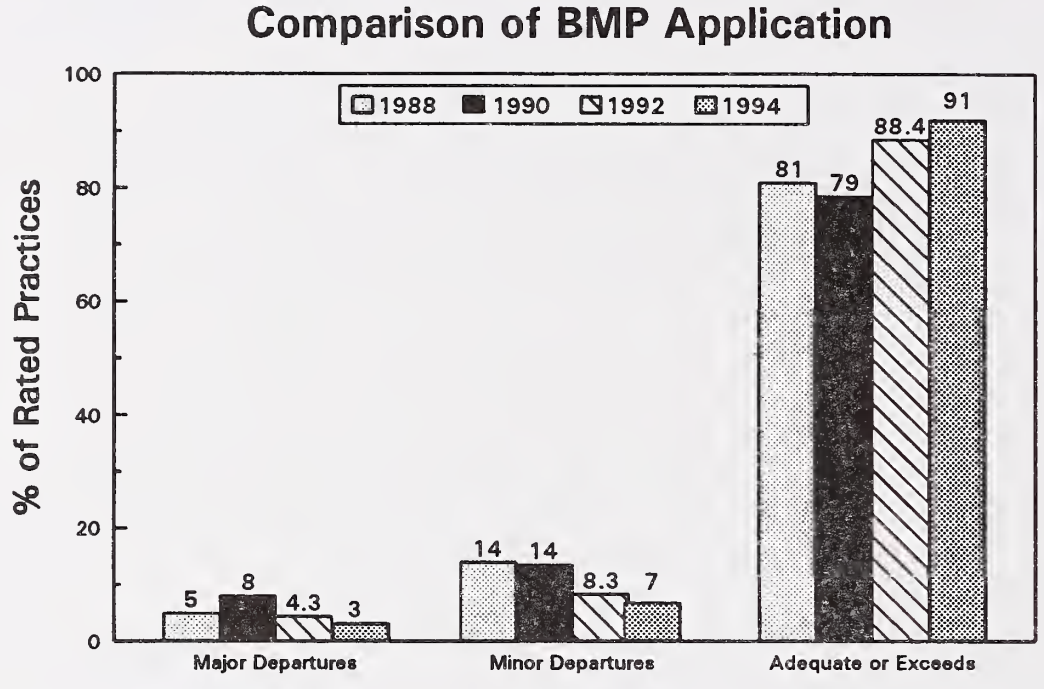


Figure 3. Major departures are practices with an application rating < 3.
Minor departures are practices with an application rating of 3.
Adequate or exceeds are practices with an application rating > 3.

Figure 4 displays BMP effectiveness results for the four forestry BMP audits conducted in Montana.

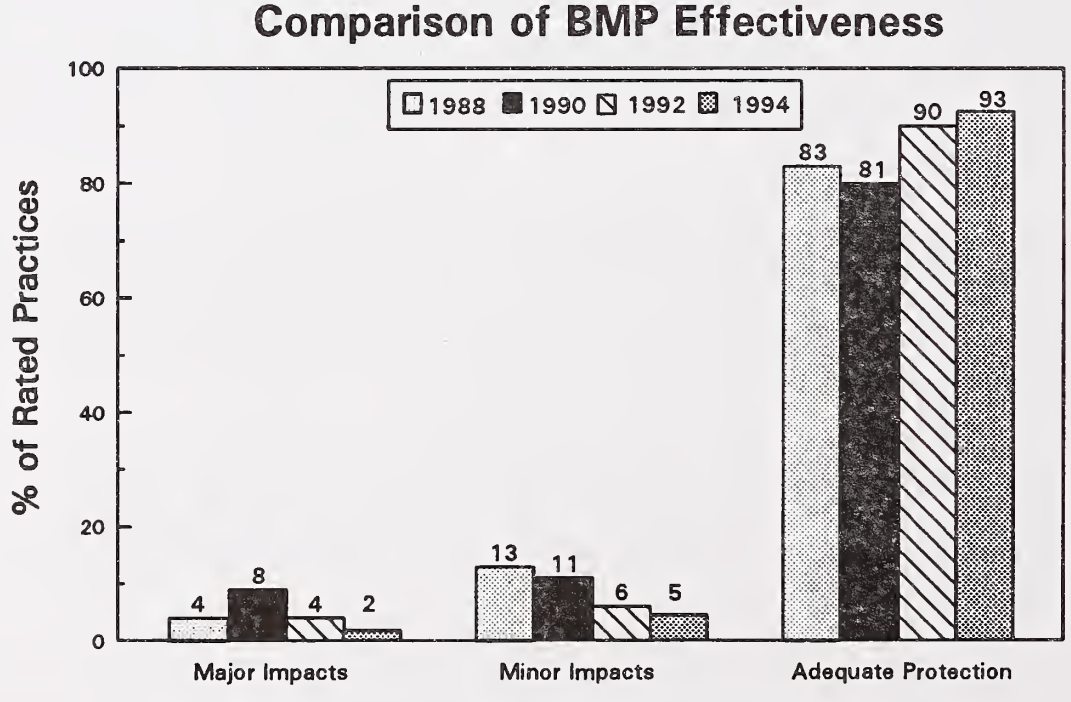


Figure 4. Major impacts are practices with an effectiveness rating < 3.
Minor impacts are practices with an effectiveness rating of 3.
Adequate protection is a practice with an effectiveness rating > 3.

The 1994 audit ratings showed improvement over the 1990 and 1992 ratings when one looks at the percent of sites with major departures or impacts, as in Figure 5.

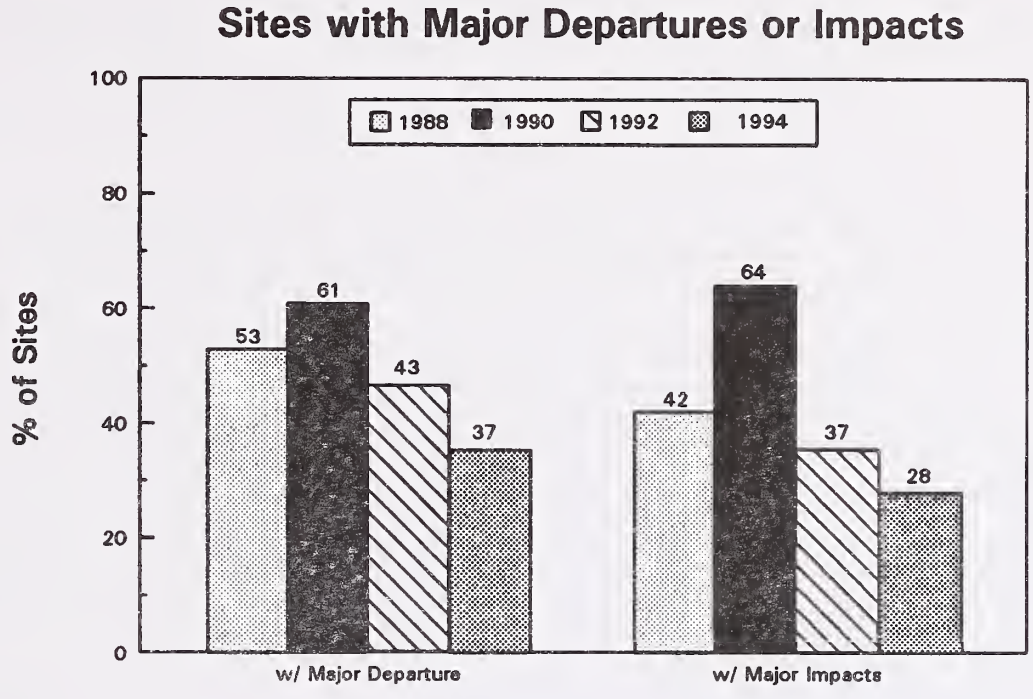


Figure 5. Major departures are practices with an application rating of 1 or 2. Major impacts are practices with an effectiveness rating of 1 or 2.

The 1994 audits had fewer major impacts per site than the 1990 and 1992 audits did. See Figure 6. Impacts per site are expressed as a percentage of rated practices per site, in order to account for differences in the average number of rated practices per site between study years.

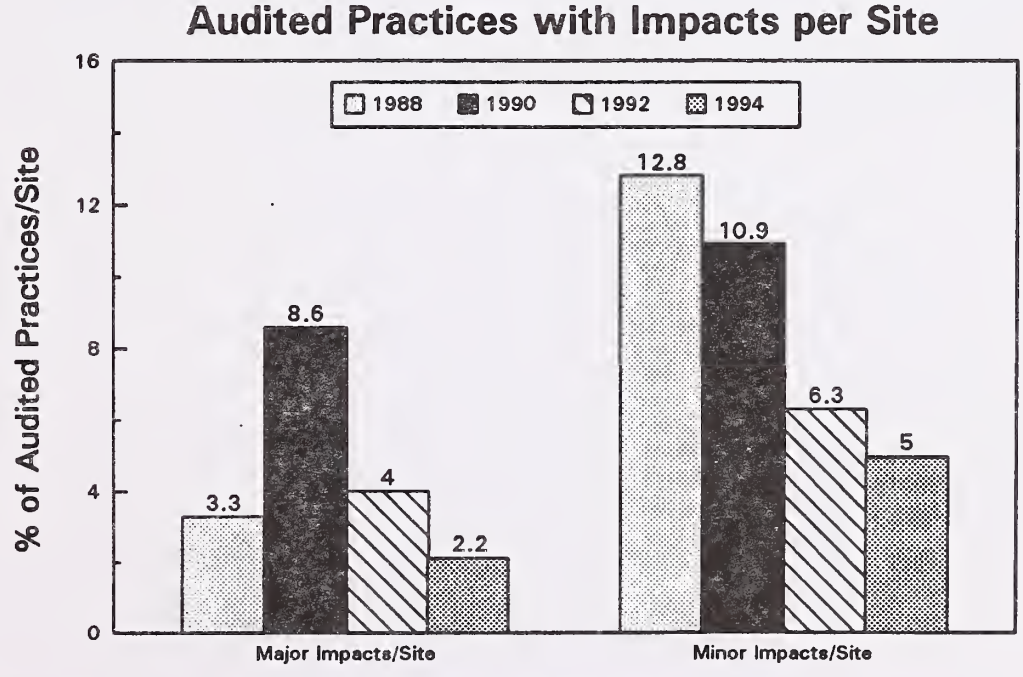


Figure 6. Major impacts are practices with an effectiveness rating of < 3. Minor impacts are practices with an effectiveness rating of 3.

RECOMMENDATIONS FROM AUDIT TEAM MEMBERS

- Continue the interdisciplinary forestry BMP audits. The audit process has been fundamental in educating and making people aware of BMP requirements. Conduct the audits every two years.

- Continue to evaluate implementation of the SMZ law and rules.

- Update the rating form. Adjust for the Streamside Management Act, and for recommended improvements to the rating guide and practices listed.

- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits. Lack of adequate drainage on new and existing roads continues to be the primary impact to water quality. BMP education should emphasize the need for meeting road drainage BMPs.

- Actively encourage the sites' owners and logging contractors to attend the audit. The Montana Logging Association and the Montana Wood Products Association will assist DSL in notifying contractors. At a minimum, give contractors a copy of the audit results for their sites.

- The team leader should encourage the landowner and contractor and, if needed in the case of NIP lands, the DSL Service Forester, to develop a remedy for problems noted. An audit team member will assist if necessary, especially to identify problems. Industry groups, such as MLA and MWPA may participate as needed.

- Continue funding volunteer audit team members.

- Institute a similar BMP audit process for other land uses, including mining, livestock grazing, agriculture and subdivision development.

References

Ehinger W. and D. Potts. 1990. On-Site Assessment of "Best Management Practices as an Indicator of Cumulative Watershed Effects in the Flathead Basin." Flathead Basin Water Quality and Fisheries Cooperative. University of Montana School of Forestry. Missoula, Montana 137 pp.

Idaho Dept. of Health and Welfare. 1989, Final Report: Forest Practices Water Quality Audit 1988. Idaho DHW, Division of Environmental Quality. Boise, Idaho, 26 pp.

Montana Dept. of Health and Environmental Sciences. 1990. Montana Water Quality, 1990. Montana DHES, Water Quality Bureau. Helena, MT. 21 pp.

National Council of the Paper Industry for Air and Stream Improvement (NCASI). 1988. Procedures for Assessing the Effectiveness of Best Management Practices in Protecting Water and Stream Quality Associated with Managed Forests. NCASI Technical Bulletin 538. January, 1988. 23 pp.

Schultz, Bill. 1990. Montana Forestry Best Management Practices Implementation Monitoring -- The 1990 Forestry BMP Audits Final Report. Montana Department of State Lands, Forestry Division, Missoula, MT. 32p.

Schultz, Bill. 1992. Montana Forestry Best Management Practices Implementation Monitoring -- The 1992 Forestry BMP Audits Final Report. Montana Department of State Lands, Forestry Division, Missoula, MT. 32p.

Zackheim, Hugh. 1988. House Joint Resolution 49--Forest Practices and Watershed Effects: Final Report. Montana Environmental Quality Council. Helena, MT. 95 pp.

APPENDIX A

7/94

1994 BMP FIELD AUDITS

BMP AUDIT TEAM MEMBERS

EXPERTISE	AUDIT TEAM		
	NORTHWEST	WEST CENTRAL	SOUTHWEST/EAST
Fisheries	+S. Rumsey, DFWP	+D. Workman, DFWP	+J. Brammer, DFWP
	+(T. Weaver, DFWP)	+(C. Clancey, DFWP)	+(G. Phillips, DFWP)
	(P. Van Eimeren, FS)	or +(D. Peters, DFWP)	
Hydrology	+A. Puffer, USFS	+G. Frank, DSL	+S. Tralles, WQB
	(B. Sugden, PC)	+(B. Schultz, DSL)	(G. Bain, EPA)
	(S. Johnson, USFS)		
Soils	+V. Cliiberti, BLM	+B. Dutton, PVT	H. Hunter, SCS
	+(T. Wiersum, SCS)	+(J. Collins, DSL)	+(M. Browne, BLM)
Forestry	+R. Hudson, PVT	+D. Wick, PC	+G. Sanders, PC
	(L. Coryell, USFS)	+(P. Davis, PC)	+(S. Flynn, LP)
Eng./Roads	+V. Anderson, PC	E. Applekamp, USFS	+J. Marshik, USFS
	+(F. McCubbins, STZ)	+(Jim Saubier, USFS)	+(S. Anderson, PVT)
Conservation	Dan Paschke, TU	+B. Benson, CFC	+P. Hackley, EIC
	+(R. Ash, Audub.)	+(B. Farling, TU)	+(C. Jones, EIC)

Legend:

REDLINE denotes Team Leader.

( ) denotes alternate.

+ denotes prior BMP audit team experience.

APPENDIX B

1992 BMP FIELD AUDITS
RISK RATING GUIDE

MONTANA "RISK" MATRIX (3/91)

TYPE		CLEARCUT				PARTIAL CUT				SITE PREP			ROADS	
SLOPE	SOIL EROD.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	MACHINE PILE/BCAR	BRDCAST BURN	OTHER	PERM.	TEMP.
0-5%	H	2	2	2	1	2**	2**	1	1	2	1	1	2**	3
	M	2	1	1	1**	2	1**	1	1	2**	1	1	1	1
	L	1	1	1	1	1	1	1	1	1	1	1	1	1
5-20%	H	4	3	2	1	4*	3	2	1	4	2	1	3	4
	M	3	2	1	1	3*	2	1	1	3	2	1	2	3
	L	2	2	1	1	2*	2*	1	1	2	1	1	2	2
20-40%	H	5	5	4*	2	5*	5*	3**	1	5	3**	1	4	5
	M	4*	4	3	1	3	3	2	1	4	3	1	3	4*
	L	3*	2	2	1	2	2	2	1	3	2	1	3*	3
> 40%	H	5	5	4	2	5	5	4	2	5	4	1	5	5
	M	5	5	4	2*	5	5	3	1	5	4	1	5	5
	L	4	4	3	1	4	4	2	1	4	3*	1	4	4

(* Indicates Mean Value Used, ** Final Group Consensus Adjustment for Internal Consistency)

MONTANA EROSION-IMPACT MATRIX

From: "Management Guidelines For Riparian Forests" by Robert Pfister and Kim Sherwood. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program.

LEGEND
1 = LOW RISK
2-3 = MODERATE RISK
4-5 = HIGH RISK

SOIL ERODIBILITY

HIGH ERODIBILITY
GRANITICS
ALLUVIUM
LACUSTRINE

MODERATE ERODIBILITY
SCHIST
SOFT/HARD SEDIMENTS
BASIC IGNEOUS

LOW ERODIBILITY
ARGILLITE/QUARTZITE
METAMORPHIC (BELT)

HIGH RISK DUE TO RIPARIAN HARVEST

"HIGH" risk will be assigned to sales with logging in riparian zones along streams. Riparian zones are located between aquatic and terrestrial environments and are identified by distinct vegetation that requires or tolerates free or unbound water. This includes but is not limited to the following habitat types: ABLA/CACA, (all phases), ABLA/OPHO, PICEA/EQAR, THPL/OPHO.

DS-49

BMP FIELD AUDITS
SITE INFORMATION

Site Number: _____ Meets Selection Criteria: _____
High Hazard: _____

Site Name: _____

Owner: _____

Legal Description: _____ County: _____

Primary Drainage: _____ Month/Year Harvested: _____

Stream Within 200 Ft.? Y / N Name: _____ Bankfull Width: _____

Unit Size: _____ Volume Removed: _____

Road Construction: _____ Length: _____

Road Reconstruction: _____ Length: _____

Slash Disposal Complete: _____ Method: _____

Logging Method: _____

Slope: 0-5% ____; 5-20% ____; 20-40% ____; 40%+ ____

Parent Material: _____

Soil Erodibility: High ___ Medium ___ Low ___

Harvest in Riparian: Y / N

Comments:

RATING GUIDE

APPLICATION
5--OPERATION EXCEEDS REQUIREMENTS OF BMP
4--OPERATION MEETS REQUIREMENTS OF BMP
3--MINOR DEPARTURE FROM BMP
2--MAJOR DEPARTURE FROM BMP
1--GROSS NEGLECT OF BMP

EFFECTIVENESS
5--IMPROVED PROTECTION OF SOIL AND WATER RESOURCES OVER PRE-PROJECT CONDITION
4--ADEQUATE PROTECTION OF SOIL AND WATER RESOURCES
3--MINOR AND TEMPORARY IMPACTS ON SOIL & WATER RESOURCES
2--MAJOR AND TEMPORARY OR MINOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.
1--MAJOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.

DEFINITIONS (BY EXAMPLE):
ADEQUATE--SMALL AMOUNT OF MATERIAL ERODED; MATERIAL DOES NOT REACH DRAWS, CHANNELS, OR FLOODPLAIN.
MINOR--EROSION AND DELIVERY OF MATERIAL TO DRAWS BUT NOT STREAM.
MAJOR--EROSION AND SUBSEQUENT DELIVERY OF SEDIMENT TO STREAM OR ANNUAL FLOODPLAIN.
TEMPORARY--IMPACTS LASTING ONE YEAR OR LESS; NO MORE THAN ONE RUNOFF SEASON.
PROLONGED--IMPACTS LASTING MORE THAN ONE YEAR.

NR--NOT REVIEWED
NA--NOT APPLICABLE

FIELD AUDIT

Date: _____

Team Leader/Recorder: _____

Team Members: _____

_____

Comments:

MONTANA FOREST PRACTICES REVIEW WORKSHEET

BMPs Applicable to:
+ New Road Construction
* Existing Roads
▸ Reconstruction

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION	EFFECTIVENESS	COMMENTS
	SECTION I--ROADS			
	ROAD PLANNING & LOCATION SECTION I.A.			
▸+	1a. MINIMIZE NUMBER OF ROADS NECESSARY.			
*	1b. USE EXISTING ROADS UNLESS AGGRAVATE EROSION.			
+	3. AVOID LONG, SUSTAINED, STEEP ROAD GRADES.			
+	4. LOCATIONS AVOID HIGH HAZARD SITES (I.E., WET AREAS AND UNSTABLE SLOPES).			
+	5. ADEQUATE SMZ BETWEEN ROAD AND STREAM CHANNELS WHERE ROADS ARE LOCATED ALONG STREAMS.			
+	6a. MINIMIZE NUMBER OF STREAM CROSSINGS. NUMBER _____.			
+	6b. CHOOSE STABLE STREAM CROSSING SITES.			
	ROAD DESIGN SECTION I.B.			
▸+	2. DESIGN ROADS TO MINIMUM STANDARD NECESSARY TO ACCOMMODATE ANTICIPATED USES.			
+	4. VARY ROAD GRADE TO REDUCE CONCENTRATED DRAINAGE.			
+▸	5. PROPER SIZING FOR CROSSING STRUCTURES.			
	DRAINAGE FROM ROAD SURFACE SECTION I.C.			
+▸*	1. PROVIDE ADEQUATE ROAD SURFACE DRAINAGE FOR ALL ROADS.			
+▸	2. SKEW DITCH RELIEF CULVERTS.			
+▸*	4. PROVIDE ENERGY DISSIPATORS AT DRAINAGE STRUCTURE OUTLETS WHERE NEEDED.			
+▸*	6. ROUTE ROAD DRAINAGE THROUGH ADEQUATE FILTRATION ZONES BEFORE ENTERING A STREAM.			

I.D. _____ + New Road Construction; * Existing Roads; ▸ Reconstruction

	RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
	CONSTRUCTION/RECONSTRUCTION SECTION I.D.				
+▸	2. STABILIZE ERODIBLE SOILS (I.E., SEEDING, BENCHING, MULCHING).				
+▸	3. SLASH FILTER WINDROWS INSTALLED.				
+▸	5. CUT AND FILL SLOPES AT STABLE ANGLES. SLOPE RATIO: _____.				
+▸	6. AVOID INCORPORATING WOODY DEBRIS IN ROAD FILL.				
+▸	8. EXCESS MATERIALS (WASTE) PLACED IN LOCATIONS THAT AVOID ENTERING STREAM.				
+▸	9. SEDIMENT FROM BORROW PITS AND GRAVEL PITS MINIMIZED.				
▸	10. RECONSTRUCT ONLY TO THE EXTENT NECESSARY TO PROVIDE ADEQUATE DRAINAGE AND SAFETY.				
	ROAD MAINTENANCE SECTION I.E.				
+▸*	1. GRADE ROADS IF NECESSARY TO MAINTAIN DRAINAGE.				
+▸*	2. MAINTAIN EROSION CONTROL FEATURES (DIPS, DITCHES AND CULVERTS FUNCTIONAL).				
*	3. AVOID CUTTING THE TOE OF CUT SLOPES.				
+▸*	6. AVOID USE OF ROADS DURING WET PERIODS AND SPRING BREAKUP.				
+▸*	8. ABANDONED ROADS IN CONDITION TO PROVIDE ADEQUATE DRAINAGE WITHOUT FURTHER MAINTENANCE.				
	SECTION II--TIMBER HARVESTING				
	HARVEST DESIGN SECTION II.A.				
	2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY, SOIL TYPE AND SEASON OF OPERATION.				
	5. DESIGN AND LOCATE SKID TRAILS TO AVOID CONCENTRATING RUNOFF.				
	6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
STREAMSIDE MANAGEMENT SECTION II.B.				
NOTE: EVALUATED AGAINST BMPS, NOT SMZ LAW.				
1. ADEQUATE SMZ MAINTAINED (WIDTH _____).				
2a. VEGETATION MAINTAINED ALONG STREAM.				
2b. RETAIN TREES FOR STABILIZATION.				
2c. OPENINGS UNDER 600 FT. ALONG CHANNEL.				
3a. EQUIPMENT OPERATION MINIMIZED IN SMZ.				
3b. AVOID EQUIPMENT OPERATION IN WETLANDS.				
3c. AVOID EQUIPMENT OPERATION IN STREAM CHANNELS.				
4. STREAMS FREE OF LOGGING DEBRIS.				
OTHER HARVESTING ACTIVITIES SECTION II.C.				
1a. SKIDDING OPERATION MINIMIZES SOIL COMPACTION AND DISPLACEMENT.				
1b. AVOID TRACTOR SKIDDING ON UNSTABLE SLOPES AND SLOPES THAT EXCEED 40% UNLESS NOT CAUSING EXCESSIVE EROSION.				
2a. ADEQUATE DRAINAGE FOR TEMPORARY ROADS, SKID TRAILS AND FIRE LINES.				
2b. ADEQUATE DRAINAGE FOR LANDINGS.				
SLASH TREATMENT AND SITE PREPARATION SECTION II.D.				
2. BRUSH BLADES USED ON DOZERS.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY.				
5. COMPACTION AND DISPLACEMENT MINIMIZED.				
6. EQUIPMENT OPERATIONS ON SUITABLE SLOPES ONLY.				
9. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE.				
SECTION III--STREAM CROSSINGS				
LEGAL REQUIREMENTS SECTION III.A.				
1. PROPER PERMITS FOR STREAM CROSSINGS.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION		EFFECTIVENESS	COMMENTS
DESIGN CONSIDERATIONS SECTION III.B.				
1a. CROSS STREAMS AT RIGHT ANGLES. IF PRACTICAL.				
1b. DIRECT ROAD DRAINAGE AWAY FROM STREAM CROSSING SITE.				
2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION III.C.				
1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE.				
3. PREVENT EROSION OF CULVERT AND BRIDGE FILLS (I.E., ARMOR INLET AND OUTLET.				
5. MINIMUM COVER FOR CULVERTS PROVIDED.				
SECTION V--HAZARDOUS SUBSTANCES				
GENERAL SECTION V.A.				
2. ADEQUATE STORAGE AND DISPOSAL FOR FUEL, SHOP DEBRIS, AND WASTE OIL.				

DID TIMBER HARVEST PLANNING INCLUDE CONSIDERATIONS FOR WATERSHED CONDITION AND CUMULATIVE EFFECTS OF MULTIPLE TIMBER MANAGEMENT ACTIVITIES ON WATER YIELD AND SEDIMENT PRODUCTION? Y / N	IF SO, HOW?

ADDITIONAL COMMENTS:

SUPPLEMENTAL QUESTIONS
STREAMSIDE MANAGEMENT ZONE LAW AND RULES
1994 BMP AUDITS

Site Name: _____ Site Number: _____

Applicability

Were any harvest practices conducted adjacent to a stream channel, lake, or other body of water? Y / N

What class of stream or type of body of water is located at the site? (Circle appropriate answer.)

Class 1 Class 2 Class 3 Lake Other Body of Water _____

Is SMZ law applicable (effective 10/1/91) Y / N

Are SMZ rules applicable (effective 3/15/93) Y / N

Were any DSL-approved site-specific alternative practices implemented in the harvest activities? Y / N

Minimum required SMZ width: _____. Width of SMZ? _____ ft.

Is SMZ adequate to protect water quality? Y / N

Broadcast Burning

Was broadcast burning conducted in the SMZ? Y / N

Equipment Operation

Was equipment operated in the SMZ off of established road? Y / N

Are pre-approved alternative practices utilized? Y / N

Retention Trees

What are the retention tree requirements? (Circle appropriate answer.)

50% 5 Trees/100 Ft. 10 Trees/100 Ft. Submerchantable

Were trees harvested from within the SMZ? Y / N

Does it appear that the retention tree requirements of the SMZ Rules were met? Y / N

Are retention trees representative of pre-harvest stand? Y / N

Were bank-edge trees and trees leaning toward the stream favored for retention? Y / N

Were shrubs and submerchantable trees protected and retained in the entire SMZ? Y / N

Road Construction

Were any roads constructed within the SMZ except where necessary to cross a stream or wetland? Y / N

Are pre-approved alternative practices utilized? Y / N

Hazardous or Toxic Materials

Were any hazardous or toxic materials handled, stored, applied or disposed of in the SMZ in a manner that might pollute a stream, lake or wetland? Y / N

Was the application of herbicides or pesticides done in a manner that prevents entry to streams, lakes, wetlands or other bodies of water through surface runoff or sub-surface flow? Y / N

Side-Casting of Road Material

Was road material side-cast into the stream, lake, wetland, or other body of water during road maintenance? Y / N

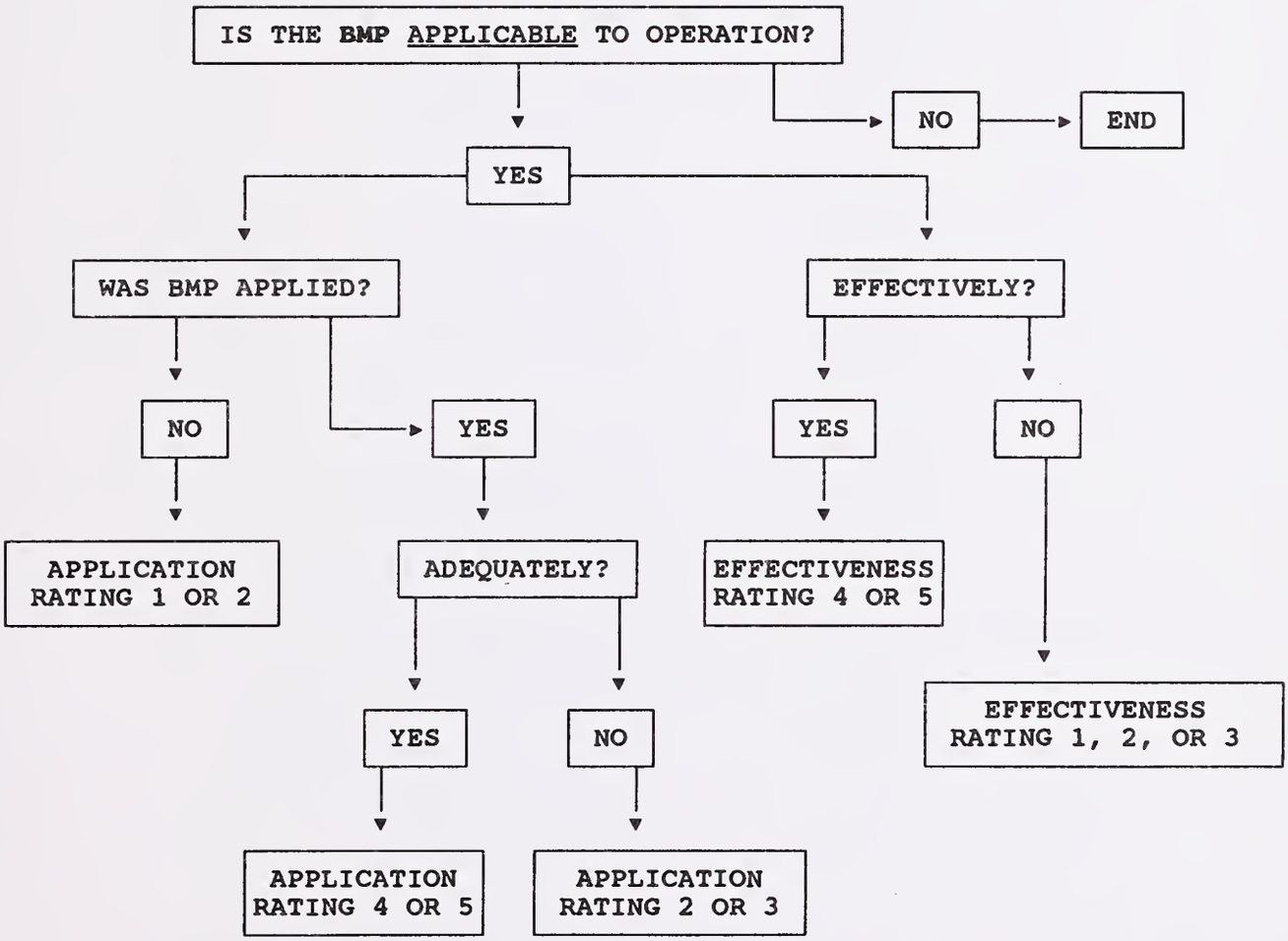
Depositing Slash

Was slash deposited in the stream, lake or other body of water? Y / N

APPENDIX D

RATIONALE FOR THE RATING SYSTEM

POST HARVEST EVALUATION



APPENDIX E

1994 BMP FIELD AUDITS
SITES PICKED FOR AUDITS
BY OWNERSHIP GROUP

Number	Sale Name	Location	County	Owner	Team
DSL-1	North Elliston	Sec. 16, T10N-R6W	Lewis & Clark	DSL	SW
DSL-2	Ritz/Fitz	Sec. 8, T34N-R24W	Lincoln	DSL	NW
DSL-3	Greyson	Sec. 16, T6N-R4E	Lewis & Clark	DSL	SW
DSL-4	Deerhorn	Sec. 36, T23N-R28W	Sanders	DSL	WC
DSL-5	Fish Forks	Sec. 26, T14N-R25W	Missoula	DSL	WC
FED-1	Wolf Davis	Sec. 30, T32N-R26W	Lincoln	USFS	NW
FED-2	East Loop	Sec. 31, T19N-R15W	Missoula	USFS	WC
FED-3	Treasure Mtn.	Sec. 3, T8N-R6W	Lewis & Clark	USFS	SW
FED-4	Eds Creek	Sec. 6, 7, T13N-R23W	Missoula	USFS	WC
FED-5	Mill Lion	Sec. 26, T11N-R9E	Lewis & Clark	USFS	SW
FED-6	Blue Rice	Sec. 9, T32N-R30W	Lincoln	USFS	NW
FED-8	Three Goats	Sec. 36, T31N-R35W	Lincoln	USFS	NW
FED-9	Maynard Creek	Sec. 13, T1N-R20W	Ravalli	USFS	WC
FED-10	Beaver Peak	Sec. 8, T26N-R34W	Sanders	USFS	WC
FED-11	North Baldy	Sec. 14, T22N-R25W	Sanders	USFS	WC
FED-12	Chamberlain	Sec. 5, T13N-R14W	Powell	BLM	WC
FED-13	FF BPA	Sec. 13, T29N-R18W	Flathead	USFS	NW
FED-14	Challenge	Sec. 32, T28N-R14W	Flathead	USFS	NW
FED-15	Alder Gulch	Sec. 15, T7S-R3W	Madison	BLM	SW
IND-1	Herrig	Sec. 25, T28N-R25W	Flathead	P.C.	NW
IND-2	Barnum	Sec. 4, T27N-R27W	Lincoln	C.I.	NW
IND-3	Horned Owl	Sec. 35, T26N-R29W	Lincoln	P.C.	NW
IND-4	West Rand	Sec. 34, T29N-R24W	Flathead	P.C.	NW
IND-5	Dan's Curl	Sec. 27, T26N-R26W	Flathead	C.I.	NW
IND-6	Minimicro	Sec. 5, T11N-R18W	Missoula	P.C.	WC
IND-7	Morrell Mtn.	Sec. 21, T17N-R14W	Powell	P.C.	WC
IND-8	Bear Run	Sec. 23, 26, T12N-R19W	Missoula	C.I.	WC
IND-9	Hell Roaring	Sec. 13, T23N-R27W	Sanders	C.I.	WC
IND-10	Crammer Conglomerate	Sec. 27, T12N-R16W	Missoula	P.C.	WC
IND-11	Johnson Line	Sec. 3, T13N-R18W	Missoula	C.I.	WC
IND-12	Preacher's Answer	Sec. 31, T32N-R34W	Lincoln	C.I.	NW
IND-13	Haw Haw	Sec. 21, T3N-R6E	Madison	BSL	SW
IND-14	Haskill	Sec. 26, T31N-R21W	Flathead	SLC	NW
NIP-1	Wineglass	Sec. 15, T12N-R10W	Powell	NIP	SW
NIP-2	Walker Creek	Sec. 5, T9N-R5W	Lewis & Clark	NIP	SW
NIP-3	Ambrose Creek	Sec. 19, T9N-R18W	Ravalli	NIP	WC
NIP-4	W. F. Petty	Sec. 28, T14N-R23W	Missoula	NIP	WC
NIP-5	Tilton Creek	Sec. 10, T2S-R48E	Powder River	NIP	SW
NIP-6	Rock Creek	Sec. 28, T26N-R32W	Sanders	NIP	WC
NIP-7	McMannamy	Sec. 33, T29N-R23W	Flathead	NIP	NW
NIP-8	Half Moon	Sec. 3, T12N-R20E	Fergus	NIP	SW
NIP-9	Red Hill	Sec. 2, T13N-R19E	Fergus	NIP	SW
NIP-10	Henderson Creek	Sec. 32, T9N-R13W	Granite	NIP	WC
NIP-11	Porcupine Creek	Sec. 24, T26N-R30W	Lincoln	NIP	NW
NIP-12	Wagon Box	Sec. 31, T3N-R33E	Big Horn	NIP	SW
NIP-13	Hawk Creek	Sec. 24, T8N-R29E	Musselshell	NIP	SW

APPENDIX F

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
ROAD PLANNING													
Minimize #	DSL	0	0	1	4	0	0	0	0	0	5	0	0
of Roads	FED	0	1	0	12	0	1	0	1	0	12	0	1
I.A.1a	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	0	12	1	0	0	0	0	13	0	0
	Total:	0	1	1	40	1	3	0	1	0	42	0	3
Use Existing	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Roads	FED	0	0	1	12	0	1	0	0	1	12	0	1
I.A.1b	IND	0	0	0	13	0	1	0	0	0	13	0	1
	NIP	0	0	0	11	0	2	0	0	0	11	0	2
	Total:	0	0	1	41	0	4	0	0	1	41	0	4
Avoid Long,	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Steep Grades	FED	0	0	0	12	0	2	0	0	0	12	0	2
I.A.3	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	1	10	0	2	0	0	1	10	0	2
	Total:	0	0	1	39	0	6	0	0	1	39	0	6
Avoid High	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Hazard Areas	FED	0	0	2	10	0	2	0	0	1	11	0	2
I.A.4	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	1	1	10	0	1	0	0	1	11	0	1
	Total:	0	1	4	36	0	5	0	0	2	39	0	5
Adequate SMZ	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Planned	FED	0	0	1	5	0	8	0	0	1	5	0	8
I.A.5	IND	0	0	0	11	0	3	0	0	0	11	0	3
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	1	25	0	20	0	0	1	25	0	20
Minimize # of	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Stream X'ings	FED	0	1	0	7	0	6	0	1	0	7	0	6
I.A.6a	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	1	6	0	6	0	0	1	6	0	6
	Total:	0	1	1	24	0	20	0	1	1	24	0	20

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
Choose	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Stable Stream	FED	0	0	0	8	0	6	0	0	0	8	0	6
Crossing Sites	IND	0	0	0	8	0	6	0	0	0	8	0	6
I.A.6b	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	26	0	20	0	0	0	26	0	20
ROAD DESIGN													
Minimum Design	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Standards	FED	0	0	1	12	0	1	0	0	2	11	0	1
I.B.2	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	1	12	0	0	0	0	0	13	0	0
	Total:	0	0	2	41	0	3	0	0	2	41	0	3
Vary Grade	DSL	0	0	1	4	0	0	0	0	0	5	0	0
for Drainage	FED	0	0	1	11	0	2	0	0	0	12	0	2
I.B.4	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	2	11	0	0	0	0	1	12	0	0
	Total:	0	0	4	38	0	4	0	0	1	41	0	4
Crossings	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Properly Sized	FED	0	0	0	10	0	4	0	0	0	10	0	4
I.B.5	IND	0	0	0	9	0	5	0	0	0	9	0	5
	NIP	0	0	1	6	0	6	0	0	0	7	0	6
	Total:	0	0	1	28	0	17	0	0	0	29	0	17
ROAD DRAINAGE													
Adequate Sur-	DSL	0	0	1	4	0	0	0	0	1	4	0	0
face Drainage	FED	0	3	4	7	0	0	0	3	3	8	0	0
I.C.1	IND	0	0	4	10	0	0	0	1	2	11	0	0
	NIP	0	4	3	6	0	0	0	3	3	7	0	0
	Total:	0	7	12	27	0	0	0	7	9	30	0	0
Skew Relief	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Culverts	FED	0	0	0	4	0	10	0	0	0	4	0	10
I.C.2	IND	0	0	0	1	0	13	0	0	0	1	0	13
	NIP	0	0	0	2	0	11	0	0	0	2	0	11
	Total:	0	0	0	10	0	36	0	0	0	10	0	36

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Energy Dissip.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
at CMP Outlets	FED	0	1	3	7	0	3	0	1	2	8	0	3
I.C.4	IND	0	0	0	9	0	5	0	0	0	9	0	5
	NIP	0	0	1	4	0	8	0	0	1	4	0	8
	Total:	0	1	4	25	0	16	0	1	3	26	0	16
Route Drainage	DSL	0	0	1	4	0	0	0	0	1	4	0	0
Through SMZ	FED	0	5	2	6	0	1	0	6	0	7	0	1
I.C.6	IND	0	1	2	9	0	2	0	1	2	9	0	2
	NIP	0	2	2	8	0	1	0	2	2	8	0	1
	Total:	0	8	7	27	0	4	0	9	5	28	0	4
ROAD CONSTRUCTION													
Stabilize	DSL	0	0	0	5	0	0	0	0	0	4	1	0
Erodible Soils	FED	0	0	0	13	0	1	0	0	0	13	0	1
I.D.2	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	3	2	8	0	0	0	0	6	7	0	0
	Total:	0	3	2	38	0	3	0	0	6	36	1	3
Slash Filter	DSL	0	0	1	1	0	3	0	0	1	1	0	3
Windrows	FED	0	2	2	4	0	6	0	1	2	5	0	6
I.D.3	IND	0	0	2	5	0	7	0	0	2	5	0	7
	NIP	0	2	1	2	0	8	0	0	3	2	0	8
	Total:	0	4	6	12	0	24	0	1	8	13	0	24
Slopes at	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Stable Angle	FED	0	0	1	11	0	2	0	1	0	11	0	2
I.D.5	IND	0	0	1	11	0	2	0	0	1	11	0	2
	NIP	0	1	0	10	0	2	0	0	1	10	0	2
	Total:	0	1	2	37	0	6	0	1	2	37	0	6
Clear Veget.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Before Const.	FED	0	0	0	12	0	2	0	0	0	12	0	2
I.D.6	IND	0	0	2	10	0	2	0	0	0	12	0	2
	NIP	0	1	2	7	0	3	0	1	1	8	0	3
	Total:	0	1	4	34	0	7	0	1	1	37	0	7

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Overburden	DSL	0	0	1	3	0	1	0	0	0	4	0	1
Placement	FED	0	0	0	2	0	12	0	0	0	2	0	12
I.D.8	IND	0	0	1	3	0	10	0	0	0	4	0	10
	NIP	0	0	0	6	0	7	0	0	0	6	0	7
	Total:	0	0	2	14	0	30	0	0	0	16	0	30
Sediment From	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Borrow Pits	FED	0	0	0	3	0	11	0	0	0	3	0	11
I.D.9	IND	0	0	0	2	0	12	0	0	0	2	0	12
	NIP	0	0	0	4	0	9	0	0	0	4	0	9
	Total:	0	0	0	11	0	35	0	0	0	11	0	35
Minimize	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Reconstruction	FED	0	0	1	9	0	4	0	0	1	9	0	4
I.D.10	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	1	2	7	0	3	0	1	2	7	0	3
	Total:	0	1	3	29	0	13	0	1	3	29	0	13
ROAD MAINTENANCE													
Grade Roads	DSL	0	0	0	5	0	0	0	0	0	5	0	0
for Drainage	FED	0	0	1	13	0	0	0	0	1	13	0	0
I.E.1	IND	0	0	1	13	0	0	0	0	1	13	0	0
	NIP	0	0	1	12	0	0	0	0	0	13	0	0
	Total:	0	0	3	43	0	0	0	0	2	44	0	0
Erosion Control	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Functional	FED	0	2	3	8	0	1	0	2	4	7	0	1
I.E.2	IND	0	0	1	13	0	0	0	0	1	13	0	0
	NIP	0	0	2	8	0	3	0	0	2	8	0	3
	Total:	0	2	7	33	0	4	0	2	7	33	0	4
Avoid Cutting	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Slope Toe	FED	0	0	1	12	0	1	0	0	1	12	0	1
I.E.3	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	1	8	0	4	0	0	0	9	0	4
	Total:	0	0	3	38	0	5	0	0	1	40	0	5

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Restrict Use	DSL	0	0	0	5	0	0	0	0	0	5	0	0
When Wet	FED	0	0	0	14	0	0	0	0	0	14	0	0
I.E.6	IND	0	0	1	13	0	0	0	0	0	14	0	0
	NIP	0	0	2	11	0	0	0	0	0	13	0	0
	Total:	0	0	3	43	0	0	0	0	0	46	0	0
Adequate Drain.	DSL	0	0	0	1	0	4	0	0	0	1	0	4
on Aband. Roads	FED	0	0	0	2	0	12	0	0	0	2	0	12
I.E.8	IND	0	0	0	3	0	11	0	0	0	3	0	11
	NIP	0	0	0	4	0	9	0	0	0	4	0	9
	Total:	0	0	0	10	0	36	0	0	0	10	0	36
HARVEST DESIGN													
Logging Suits	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Topography	FED	0	1	0	13	0	0	0	1	0	13	0	0
II.A.2	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	1	1	44	0	0	0	1	0	45	0	0
Skid Trail	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Design	FED	0	0	2	12	0	0	0	0	1	13	0	0
II.A.5	IND	0	0	2	9	0	3	0	0	0	11	0	3
	NIP	0	3	1	9	0	0	0	1	2	10	0	0
	Total:	0	3	5	35	0	3	0	1	3	39	0	3
Landing Size	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Location	FED	0	0	0	14	0	0	0	0	1	13	0	0
II.A.6	IND	0	0	1	13	0	0	0	0	0	14	0	0
	NIP	0	0	1	12	0	0	0	0	0	13	0	0
	Total:	0	0	2	44	0	0	0	0	1	45	0	0
STREAMSIDE MANAGEMENT													
Adequate SMZ	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Maintained	FED	1	2	0	10	1	1	1	0	1	11	0	1
II.B.1	IND	0	0	0	13	1	0	0	0	0	14	0	0
	NIP	0	0	0	11	1	1	0	0	0	12	0	1
	Total:	1	1	0	39	3	2	1	0	1	42	0	2

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Stream Veget.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Maintained	FED	0	1	0	12	0	1	0	1	1	11	0	1
II.B.2a	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	12	0	1	0	0	0	12	0	1
	Total:	0	1	0	43	0	2	0	1	1	42	0	2
Retain Bank	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Trees	FED	0	1	0	12	0	1	1	0	0	12	0	1
II.B.2b	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	12	0	1	0	0	0	12	0	1
	Total:	0	1	0	42	0	3	1	0	0	42	0	3
Stream Openings	DSL	0	0	0	5	0	0	0	0	0	5	0	0
<600 Feet	FED	0	0	0	13	0	1	0	0	1	12	0	1
II.B.2c	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	12	0	1	0	0	0	12	0	1
	Total:	0	0	0	44	0	2	0	0	1	43	0	2
Equip. Operation	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Minimized in SMZ	FED	0	1	1	11	0	1	1	0	1	11	0	1
II.B.3a	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	1	11	0	1	0	0	1	11	0	1
	Total:	0	1	2	41	0	2	1	0	2	41	0	2
Equip. Operation	DSL	0	0	0	3	0	2	0	0	0	3	0	2
in Wetlands	FED	0	0	1	3	0	10	0	0	0	4	0	10
II.B.3b	IND	0	0	0	6	0	8	0	0	0	6	0	8
	NIP	0	0	2	6	0	5	0	1	0	7	0	5
	Total:	0	0	3	18	0	25	0	1	0	20	0	25
Equip. Operation	DSL	0	0	0	5	0	0	0	0	0	5	0	0
in Streams	FED	1	0	0	12	0	1	1	0	0	12	0	1
II.B.3c	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	1	0	11	0	1	0	0	1	11	0	1
	Total:	1	1	0	42	0	2	1	0	1	42	0	2

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Streams Free of	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Logging Debris	FED	0	0	2	11	0	1	0	0	0	13	0	1
II.B.4	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	2	10	0	1	0	0	2	10	0	1
	Total:	0	0	4	40	0	2	0	0	2	42	0	2
OTHER HARVEST ACTIVITY													
Skid to Min.	DSL	0	0	1	4	0	0	0	0	1	4	0	0
Displacing Soil	FED	0	1	0	11	1	1	0	1	0	12	0	1
II.C.1a	IND	0	1	1	11	1	0	0	2	0	12	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	2	2	39	2	1	0	3	1	41	0	1
Skid to Min.	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Compacting Soil	FED	0	0	0	12	0	2	0	0	0	12	0	2
II.C.1b	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	1	43	0	2	0	0	0	44	0	2
Adequate Drain.	DSL	0	0	2	3	0	0	0	0	1	4	0	0
for Skid Trails	FED	0	0	2	11	0	1	0	0	1	12	0	1
II.C.2a	IND	0	0	2	8	0	4	0	0	0	10	0	4
	NIP	1	0	1	10	0	1	0	1	1	10	0	1
	Total:	1	0	7	32	0	6	0	1	3	36	0	6
Adequate Drain.	DSL	0	0	0	5	0	0	0	0	0	5	0	0
for Landings	FED	0	0	0	14	0	0	0	0	0	14	0	0
II.C.2b	IND	0	0	0	14	0	0	0	0	0	14	0	0
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	46	0	0	0	0	0	46	0	0
SITE PREPARATION													
Brush Blades	DSL	0	0	0	1	0	4	0	0	0	1	0	4
Used	FED	0	0	0	4	1	9	0	0	0	5	0	9
II.D.2	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	0	1	0	12	0	0	0	1	0	12
	Total:	0	0	0	14	1	31	0	0	0	15	0	31

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Scarify Only	DSL	0	0	0	4	0	1	0	0	0	4	0	1
to Extent	FED	0	0	0	12	1	1	0	0	0	13	0	1
Necessary	IND	0	0	0	14	0	0	0	0	0	14	0	0
II.D.4	NIP	0	0	0	10	0	3	0	0	0	10	0	3
	Total:	0	0	0	40	1	5	0	0	0	41	0	5
Compaction and	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Displacement	FED	0	1	1	12	0	0	0	1	2	11	0	0
Minimized	IND	0	0	1	12	0	1	0	0	0	13	0	1
II.D.5	NIP	0	0	0	10	0	3	0	0	0	10	0	3
	Total:	0	1	2	36	0	7	0	1	2	36	0	7
Dozer Operation	DSL	0	0	0	2	0	3	0	0	0	2	0	3
on Suitable	FED	0	0	0	14	0	0	0	0	0	14	0	0
Slopes Only	IND	0	0	0	13	0	1	0	0	0	13	0	1
II.D.6	NIP	0	0	0	10	0	3	0	0	0	10	0	3
	Total:	0	0	0	39	0	7	0	0	0	39	0	7
Limit WQ Impact	DSL	0	0	1	1	0	3	0	0	0	2	0	3
of Fire	FED	0	0	2	8	0	4	0	0	2	8	0	4
II.D.9	IND	0	0	0	12	0	2	0	0	0	12	0	2
	NIP	0	0	0	5	0	8	0	0	0	5	0	8
	Total:	0	0	3	26	0	17	0	0	2	27	0	17
STREAM CROSSINGS													
Proper Permit	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Obtained	FED	0	0	0	6	0	8	0	0	0	6	0	8
III.A.1	IND	0	0	0	3	0	11	0	0	0	3	0	11
	NIP	0	1	0	3	0	9	0	0	1	3	0	9
	Total:	0	1	0	16	0	29	0	0	1	16	0	29
STREAM XING DESIGN													
Cross Stream	DSL	0	0	0	3	0	2	0	0	0	3	0	2
at Right Angle	FED	0	0	0	8	0	6	0	0	0	8	0	6
III.B.1a	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	0	26	0	20	0	0	0	26	0	20

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Reduce Concen.	DSL	0	0	2	1	0	2	0	0	1	2	0	2
of Runoff	FED	0	3	3	2	0	6	0	3	2	3	0	6
III.B.1b	IND	0	1	1	6	0	6	0	0	2	6	0	6
	NIP	0	1	3	3	0	6	0	1	3	3	0	6
	Total:	0	5	9	12	0	20	0	4	8	14	0	20
Avoid Unimproved	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Crossings	FED	0	0	0	7	0	7	0	0	0	7	0	7
III.B.2	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	0	5	0	8	0	0	0	5	0	8
	Total:	0	0	0	23	0	23	0	0	0	23	0	23
STREAM XING INSTALLATION													
Min. Channel	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Disturbance	FED	0	0	1	8	0	5	0	0	1	8	0	5
III.C.1	IND	0	0	0	8	0	6	0	0	0	8	0	6
	NIP	0	0	0	7	0	6	0	0	0	7	0	6
	Total:	0	0	1	27	0	18	0	0	1	27	0	18
Culverts Conform	DSL	0	0	0	4	0	1	0	0	0	4	0	1
to Streambed	FED	0	0	2	7	0	5	0	0	2	7	0	5
Slope	IND	0	0	0	7	0	7	0	0	0	7	0	7
III.C.2	NIP	0	2	1	2	0	8	0	1	2	2	0	8
	Total:	0	2	3	20	0	21	0	1	4	20	0	21
Prevent Fill	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Erosion	FED	0	0	3	6	0	5	0	0	3	6	0	5
III.C.3	IND	0	0	1	7	0	6	0	0	1	7	0	6
	NIP	0	0	1	5	0	7	0	0	1	5	0	7
	Total:	0	0	5	22	0	19	0	0	5	22	0	19
Adequate Cover	DSL	0	0	0	4	0	1	0	0	0	4	0	1
for Culverts	FED	0	0	0	8	0	6	0	0	0	8	0	6
III.C.5	IND	0	0	0	7	0	7	0	0	0	7	0	7
	NIP	0	0	0	5	0	8	0	0	0	5	0	8
	Total:	0	0	0	24	0	22	0	0	0	24	0	22

1994 BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
HAZARDOUS SUBSTANCES													
Proper Storage	DSL	0	0	0	5	0	0	0	0	0	5	0	0
and Disposal	FED	0	0	0	14	0	0	0	0	0	14	0	0
V.A.2	IND	0	0	0	13	0	1	0	0	0	13	0	1
	NIP	0	0	0	13	0	0	0	0	0	13	0	0
	Total:	0	0	0	45	0	1	0	0	0	45	0	1
GRAND	TOTALS:	3	51	124	1731	8	613	4	39	95	1778	1	613

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